Electrical Review

THE PIONEER ELECTRICAL WEEKLY OF AMERICA.

VOL. XXXVIII. No. 22. NEW YORK, SATURDAY, JUNE 1, 1901. ISSUED WEEKLY.

ELECTRICAL REVIEW

Park Row Building,
13-21 Park Row, New York.
P. O. Box 2339.

By the
ELECTRICAL REVIEW PUBLISHING COMPANY.
CHARLES W. PRICE,
President and Treasurer.
STEPHEN H. GODDARD,
Secretary.
RUSSELL HOWLAND,
General Representative.

Registered Cable Address:
"Electview," - New York.
Telephone Call, 21 "Cortlandt."
(Private branch exchange connecting all departments.)

Western Office:
1612-1613 Marquette Building, Chicago.
London Office:
42 Old Broad Street, London, E. C.

Subscriptions to the
ELECTRICAL REVIEW.

One Year, United States and Canada, - - $3.00
One Year, Foreign Countries, - - - - - - 5.00
Single Copies, each, - - - - - - - - .10
Copies can be supplied for only one year back at 25 cents each.

To Advertisers

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.
NEW ADVERTISEMENTS should be in the office not later than Monday noon to insure publication in that week's issue.

"About this time look out for the lightning-rod man." If there were a Farmers' Almanac published to-day this sentence should have a prominent place in it on this date. It is a good caution to print, anyway. If anybody is really alarmed about lightning and thinks seriously of lightning rods, let him first wisely invest a small amount in the purchase of Professor Lodge's book on "Lightning Conductors," rather than fall a victim to the wiles of the lightning-rod agent. The ordinary lightning rod of commerce is pretty to look at and is not much more liable to be struck by lightning than its immediate surroundings. It is not especially dangerous, but a good thrifty tree near the house is a better protection.

A MUNIFICENT GIFT.

The presentation to the American Institute of Electrical Engineers by Dr. Schuyler S. Wheeler of the Latimer Clark library of electrical books is the largest single gift that the Institute has received in its history, and is one that reflects equal credit upon the generosity and the intelligence of its donor. Dr. Wheeler has performed a service to American electricians which they will not soon forget, and the Institute is fortunate in having in its membership one so interested in its welfare and so generous in its behalf.

The study of the history of electricity has not been as popular in the United States as its importance demands. The clearest insight into the future and into the tendencies of the present can be had by the study of the history of the past. This applies as well to engineering or science as to any other department of human advance. With this library at its command and added to its already excellent collection of books, the Institute has the nucleus around which will crystalize, in the course of time, a great electrical library.

Now that the example has been so well set by Dr. Wheeler, the other members of the Institute should come forward and endeavor to make this great library an actual reality instead of a mere possibility. There should be a generous rivalry among them to see who could give the most and the best toward this object.

Measured by the importance of the profession it represents and by the productive capacity of its members as inventors, engineers and men of science, the American Institute of Electrical Engineers is second to no scientific body in the world. It comprises in its membership the elect of our men of science and engineering, and its general meetings are notable gatherings of men with brains to handle the great problems which the complexity of civilization to-day presents. Notwithstanding the importance of the Institute and the greatness of the industry of which it is the flower, it has not yet a permanent home of its own nor has it the unity of sentiment that would be given it by a suitable house in which its members could more frequently meet one another and discuss the matters in which they have common interest. The library which will grow up around the collection that Dr. Wheeler has given is an additional reason for the erection or purchase of a proper building for the Institute. With a membership of over twelve hundred, it ought not to be difficult to raise the money for this purpose, especially if Dr. Wheeler's example becomes contagious.

It is a good time for gift-making. We have had a prosperous season and most members of the Institute are doubtless in a good position to give something for this excellent purpose. If every member contributed a few books or a few dollars toward the library each year it would soon attain the proportions that the library of such a society should have. If the members who are blessed with large means should get together and discuss the question of building a house for the Institute there is no reason to believe that such a house would not quickly be erected. It is urgently to be hoped that these matters will be discussed at length at the meeting this summer, and before. It is the duty of every member of the Institute to see that every effort of his own is directed toward making the Institute the most powerful and influential organization of its kind. It is equally the duty of every person connected with the electrical field to become an associate member and contribute both by his presence and of his means to the support of this extremely important and valuable organization.

The New York newspapers are again discussing the burning question of passengers standing in the aisles of open trolley cars. This custom is practiced to a considerable extent in New York, and needless to say is disagreeable and disgust-

ing. The trouble is that under present conditions it is necessary. When Manhattan Island was made by the action of natural forces it came from Nature's workshop an ideal place for a great city, but the unfortunate ignorance and short-sightedness of the municipal commission which laid out its streets about a century ago gave us some two hundred cross streets in the direction in which there is little travel, and ten avenues, several of them interrupted in the middle of their course by a park, in the direction in which half a million people move one way or the other daily. The consequence is congestion and a volume of travel at certain hours such as is not to be found anywhere else in the world. If the municipal authorities ordain that passengers must not stand up in the aisles of open cars, it means that many of them must be left waiting on street corners. To attempt to force the street railway management to put on more cars would virtually exclude other vehicles from the streets. As a matter of fact, there are too many cars in the streets now. The question is one, after all, of point of view. If one happens to be seated in the open car and some one stands in front of him he is naturally not pleased and thinks an ordinance should prevent this practice. If, however, he is in a hurry and has to take a car to go somewhere, with the choice between standing in an aisle and waiting on the corner, nine times out of ten he will get aboard the car and stand where best he may.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

At the close of the recent convention of the National Electric Light Association, President Cahoon called attention very forcibly to the importance of enlisting a wider interest in the work of that body and of increasing its membership in some proportion to the importance of the industry it serves. Membership of the association is held by somewhat less than two hundred corporations and individuals engaged in electric lighting, whereas it certainly should have a membership total in the neighborhood of one thousand. The ancient adage that "in union there is strength," is nowhere more vitally exemplified than in associations of this character. Much of the commercial history of the Anglo-Saxon people has been dependent upon the united action of trade guilds and bodies similar in their general purpose and scope of action to this association. Where a business is so dependent on standardization and where its scattered units are as helpless in the face of hostile or ignorant legislation as is the electric light industry, there is urgent reason for the combination of all its intelligence and resources in some way to work for the common good and to defeat the common evil. This is just what the association is doing and has done for its membership, and incidently its benefits have been widely enjoyed by the electric lighting concerns outside of its membership. If for no other reason than recognition of the good work that the association has done in years past, every electric light company in the United States should be a contributing member, but the value, the importance and the strength of this association, provided every lighting company were an active and interested member, would be such that the industry would advance at a far more rapid pace, many of the rough places in the way would be smoothed out, and competition with the well-organized gas industry would be made far easier and more certain.

It is to be hoped that the suggestions and admonitions of President Cahoon may not be forgotten and that before the next general meeting the association may exhibit a widely increased list of members. While its growth has been gratifying and its work has been astonishingly efficient, still there must remain a feeling that it is a large task which has been undertaken by a small proportion of the lighting interests in fostering this association, and that the excellent results already shown should command the assistance of all in any way connected with the industry.

DIRECT VERSUS ALTERNATING CURRENT.

A few days ago two meetings of great significance took place simultaneously, the one at Niagara Falls where the National Electric Light Association was assembled, and the other in New York where, at the annual meeting of the American Institute of Electrical Engineers, the new storage battery of Mr. Edison was described. At the Electric Light Convention the most noticeable tendency in papers and discussions was the exaltation of the alternating current and the rapid suppression of direct-current methods and apparatus in favor of this more recent development. At the Institute meeting, however, there were shown promise of something that would make the direct current again exceedingly prominent in engineering work. If the storage battery is perfected to the point that we have reason to believe from Mr. Edison's statements, then we may prepare to see a considerable change in methods of power application and transmission. There is a point at which it would be cheaper and more satisfactory to transport charged storage batteries over a given distance than to transmit current itself upon conductors.

Notwithstanding, however, the important addition to the means for handling direct current which is promised in this new development, it seems as if the future would see the alternating and polyphase system becoming more and more important and meeting with wider and constantly extending use. The electrification of the steam railroads, which the logic of events will shortly bring about, will most likely be accomplished through the agency of alternating currents. Indeed, this seems to-day entirely certain and there is no apparent reason why the work should not begin now.

The perfection of the storage battery, and particularly the increase in its weight efficiency, will doubtless have a most important bearing upon the future of automobilism. To-day the electric vehicle is almost purely and entirely an instrument of pleasure; to-morrow it most likely will take the place of all other agencies of transportation in city work and for other specific purposes. This will likely be one of the most important remaining uses of direct current.

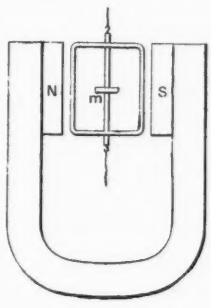
It seems to be the general tendency of engineering development to adapt alternating current for all varieties of electric lighting. The newer forms of electric lights, which are as yet in the laboratory stage, practically require alternating current for their proper operation. The outcome of this tendency will doubtless be to leave to the direct current only the local and light service railway, electrochemical processes, and applications where storage batteries are required, such as automobiles.

Science Brevities

The Aurora Borealis—From careful observations on the aurora borealis, Professor Paulsen has arrived at the conclusion that the spectrum of the light given is identical with the "cathodic" spectrum of nitrogen. This point is of interest in connection with the latest theory of the origin of this remarkable phenomenon, which attributes it to a stream of the Thomson corpuscles emitted from the sun. As these approach the magnetic field of the earth they are deflected toward the poles, and when they finally reach a level at which the air is of the proper density, they give rise to light phenomena similar to those obtained with cathode rays in suitable vacuum tubes.

Tests on Insulating Gloves—In a recent communication to a French technical society, M. P. Janet describes some valuable experiments upon ordinary insulating gloves. The work was done under the auspices of L'Association des Industriels de France. Two series of trials were made. First, tests of insulation at low tension; and, second, measurements of breakdown point under higher tensions. The first series were made with the gloves both dry and wet, while the second were made only with wet gloves, to represent the worst conditions that might be found in practice. In making the first series of tests with the dry gloves they were immersed in a vessel containing mercury, the glove itself being filled with mercury, and the resistance between the interior and exterior bodies of the metal were measured. The tests on wet gloves were made by filling them inside with wet sand and immersing them in wet sand to the same level outside, the sand being moistened with a solution of sal ammoniac to make it conducting. The gloves were allowed to remain wet 36 hours before the tests were made. Tests on six samples gave dry insulations varying all the way from zero to 52,500 megohms. The same gloves wet ranged from zero to 420 megohms. The breakdown tests were made with the same apparatus employed for the wet tests, an alternating pressure being gradually increased until the glove broke down. Of the six samples tried, three broke down immediately, one supported 1,000 volts for three minutes, one broke down at 3,000 volts, and another supported 11,000 volts, but brush discharges formed over the top of the glove, and after one minute of 12,200 volts, this sample also broke down. Unfortunately, M. Janet's report states nothing about the construction of these gloves, but it shows that at least half of the types for sale on the French market are valueless.

Compensated Measuring Instruments—In a communication to the French Academy of Sciences M. P. Weiss describes an ingenious modification of electric measuring instruments in which a permanent magnet is utilized to furnish a field of force through which a coil carrying an electric current moves. In all such instruments, as is well known, the magnet suffers more or less change with time and these changes may be either increase or decrease of the magnetic moment of the permanent magnet according to whether it produces



Compensated Measuring Instrument.

or works against the deflection. The illustration exhibits the method used to compensate the two effects. A small needle of soft iron is rigidly connected with a movable coil. Should the permanent magnet increase in strength the tendency of the coil deflections will also be to increase; but the presence of the needle, if the latter is saturated, will so compensate as to produce the same deflection as before. Both ammeters and voltmeters have been made on this plan and it is stated that they have operated very well.

Artificial India Rubber—A French contemporary describes a new process for making artificial india rubber. The inventor mixes the fibre of ramie with the milky juice of a Chinese plant whose botanical name is *abornamortana brassa*. This gum is known commercially in England as Pontianak gum. The synthesis of rubber is undertaken by the assimilation of gums and fibres of the same family which, under certain conditions, seem to have a natural affinity for one another and give an elastic material having the properties of rubber. The ramie fibre is, preferably, first dried, and the oily and volatile matters which it contains are removed. The gummy juice is then mixed with the fibre and the mixture crushed between cylinders heated to a temperature of 50 degrees centigrade. It is passed back and forth between these until the two constituents are completely incorporated in one another. The mass is then placed in an oven, the temperature of which is 150 degrees centigrade, and this temperature is raised gradually to a point between 175 and 205 degrees. After about four hours this process is completed. When the mass is cooled it is seen that, although the fibrous structure remains, its textile resistance is completely destroyed. The mixture is then worked at a temperature of 50 degrees in a mixing mill until the fibrous structure is entirely destroyed and the mass is uniform. During this last treatment substances giving off oxygen, such as borate of manganese or permanganate of potassium, are introduced, to the proportion of from five to eight per cent, and, if desired, a softening material such as balata gum up to about 10 per cent; sulphur may also be added. This process being completed, the mass is allowed to cool for about 40 hours, to permit thorough assimilation, and the mass is then cooked by steam under a pressure of 50 pounds to the square inch, for about three hours. When the product is cool it is stated to have all the qualities of india rubber. The following formulæ give various grades of product: Gum, 80 per cent; fibre, 15 per cent; sulphur, 5 per cent. This gives a good marketable quality of flexible rubber. A better quality of the same product is made from the mixture of gum, 72 per cent; fibre, 10 per cent; balata, 10 per cent; sulphur, 8 per cent. A flexible material, excellent for the manufacture of hard-rubber objects, is made of gum, 75 per cent; fibre, 20 per cent; sulphur, 5 per cent. In the first formula given, the sulphur may be replaced by permanganate.

Calcium Carbide and Phylloxera—It was discovered several years ago that calcium carbide has a powerful and valuable effect in destroying the fungus disease of the grapevine known as phylloxera. In the French press has recently been published an account of experiments, covering the last three years, carried on by Professor Vasselière, of La Gironde. The tests have indicated that carbide is both cheaper and more satisfactory than carbon bisulphide. The material employed is slack, waste and dirty carbide—practically the refuse of the works—or else material specially rich in phosphorus compounds. It appears that the phosphoretted hydrogen liberated when this compound is in contact with damp soil is the agent that kills the phylloxera and mildew. In treating vineyards, the best results have been attained by the use of about 400 pounds of carbide per acre, the material being measured in a vessel containing about a handful and buried in holes about eight inches deep.

THE THEORY OF ALTERNATING DYNAMO ELECTRIC MECHANISMS—XXVIII.

BY W. ELWELL GOLDSBOROUGH.

The chief value of the present discussion is to point out the possibility of adjusting the capacity in the circuit O′A′ in such a way as to maintain any desired voltage at the terminals OA_1 for any given load upon the circuit O″A″. In commercial practice large condensers are seldom used; however, the circuit O′A′ but typifies a synchronous motor in the condenser and resistance elements which it contains. By the conditions imposed in Fig. 76 the synchronous motor is supposed to be operated under a constant load and field excitation, both of which, as will be later pointed out, can frequently in practice be varied for the purpose of securing uniform voltage at specific points distant from the power generator.

If a mathematical treatment of these conditions is desired recourse can be had to equation (190), when

$$I = \frac{E}{\sqrt{\left(r_1 + \frac{g_2' + \frac{1}{r_2''}}{\left(g_2' + \frac{1}{r_2''}\right)^2 + (b')^2}\right)^2 + \left(x_1 + \frac{b_2'}{\left(g_2' + \frac{1}{r_2''}\right) + (b_2')^2}\right)^2}}$$

which applies to the present case with the same force as to the system shown in Fig. 71. The only difference occurs in the values of g and b, where capacity is present in the reactive branch of the receiver circuit. In this case,

$$g_2' = \frac{r_2'}{(r_2')^2 + \left(\frac{1}{c_2'\,\omega}\right)^2};$$

and

$$b_2' = \frac{\frac{1}{c_2'\,\omega}}{(r_2')^2 + \left(\frac{1}{c_2'\,\omega}\right)^2}.$$

Any problem, therefore, involving such elements as are here brought into play can be solved either graphically, as already indicated, or can be handled entirely mathematically, the values being determined by a proper substitution of the constants of the system, the variable resistance values and the corresponding generator electro-motive force.

To bring out somewhat more clearly the method of applying these principles to a practical case we will take up the consideration of a numerical example.

Example 16.

Given: An alternator developing a constant electro-motive force of 100 volts at 60 cycles; the impedance of the armature of this machine is so small that it may be neglected. The generator is connected through the medium of a transmission line to a receiving station. The resistance of the receiving line is equal to .26 of an ohm, and its reactance to .52 of an ohm. This makes a constant line impedance of .58 of an ohm At the receiving station power is supplied to two elements; one of these, M, has a constant resistance of .65 of an ohm and a capacity reactance at 60 cycles of 2.42 ohms. The second element, L, varies in its resistance by successive steps. Initially the element L is on open circuit. When the circuit is made a resistance of 2.5 ohms is first apparent, and by successive changes to no load on this element the resistance varies to 1.25 ohms, to .83 of an ohm, to .63 of an ohm.

Determine what variations will occur in the electro-motive force at the receiver station terminals of the line corresponding to changing loads on the element M. Determine also the value of the line current and the line electro-motive force in each case.

The solution of this problem we will carry out by the application of graphical methods, applying them in substantially the same way as in the case of Example 15. Initially, we will assume a constant electro-motive force of 100 volts to be maintained at the terminals of the receiver and circuit, and, following this assumption, develop the values the other quantities will have. By this process OA_1 of Fig. 77 is made equal to 100 volts. As initially the circuit through the element L or O″A″ is open, we have simply 100 volts impressed on the element M, and, therefore, by equation (54)

$$I^a = \frac{100}{\sqrt{(.65)^2 + (2.42)^2}} = 40 \text{ amperes}$$

will flow both in the element M, the line and the generator. We can, therefore, lay off the triangle of the electro-motive forces of the circuit O′A′ as represented by $OC_1^a A_1$. Here, of course, $OC_1^a = I^a r_2'$ and $C_1^a A_1 = I^a x_2'$. From this beginning the diagram, Fig. 77, is rapidly built up, the other vector quantities being evaluated by the exponent designation letters which appear in Fig. 77 and in Table 9. For instance, when the resistance of the element L has been reduced to 1.25 ohms, the resulting diagram with the following values is shown by the following vectors: $OA_1 = E_2 = 100$ volts; $OC_2^c = E_{2r} = 92.1$; $C_2^c A_1 = E = 39.4$; $A_1 C_1^c = E_{1r} = 25.7$; $C_1^c A^c = E_{1x} = 51.0$; $A_1 A^e = E_1 = 56.6$; $OA^c = E = 118$; $OB_{2_{11}}^{\ c} = I_2'' = 80$; and, finally, $OB^c = I = 98$.

The final values which are required by the statement of the problem are obtained from Fig. 77 and Table 9 to the process of proportional reduction. By it it becomes necessary to reduce the vectors OA^a, OA^b, OA^c, OA^d, and OA^e to a common length. Thus we can lay off in Fig. 78 the vector OA having a length of 100 units. Upon this vector, as an initial line, the a exponent diagram is built up as indicated by the a exponent letters The values of each of the vector quantities used in the construction of this diagram are obtained from Table 9 by increasing the a set of values in the ratio of 100 to 84. The result of this change is shown in the a values of Table 10. By reference

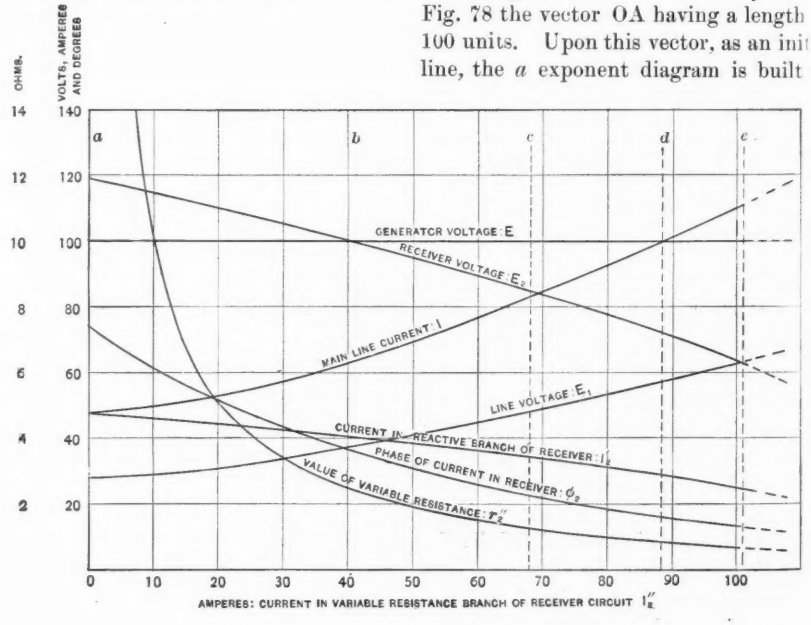


FIG. 79.—ALTERNATING-CURRENT MECHANISMS

to Fig. 78 and Table 10, therefore, we have that the vector $OB^a = I = 48$. The vector $OA_1{}^a = E_2 = 119$ and the vector $A_1{}^aA = E_1 = 27.8$, and so on, for the other values of the set. In the same way the *b* series of values of Table 9 are converted into the *b* series of values of Table 10 by changing them in the ratio of 100 to 100, since OA^b of Fig. 77 has a value of 100 volts. On the other hand, the *c* values of Table 9 are changed to the *c* values of Table 10 by multiplying the former by the ratio of 100 to 118. This gives us the vector $OB^c = I = 83$; the vector $OC_2{}^c = E_{2r} = 78$; the vector $C_2{}^cA_1{}^c = E_{2x} = 33.4$; the vector $OA^c = E_2 = 84.7$, and so on, for the other vector values. It will be seen that, between the no load and full load resistance values of the element L, the voltage impressed on this element from the generator varies from 119 to 63 volts, which is a greater change than that involved by the conditions presented in Example 15. The final values of the line current are shown in Fig. 78 as abutting against the locus curve $B^aB^bB^cB^dB^e$. Initially, the current is in advance of the generator electro-motive force, but as the load comes on the element L the angle of advance rapidly diminishes. For the value of r_2'' of about .90 of an ohm the main line current is in phase with the generator electro-motive force, but for greater reductions in the value of r_2'' it takes a lagging position relatively to E. The electro-motive force absorbed by the impedance of the line gradually increases from an initial value of 27.8 volts, as shown by the vector $A_1{}^aA$, to 63.3 volts when the load on the element L is 88 amperes, which is a variation of 288 per cent.

In Fig. 77, of necessity, the current in the element M is constant of 40 amperes. In Fig. 78, however, on account of the variation of the pressure at the terminals of the element M the current taken by it varies from 48 to 25 amperes, as r_2'' varies; consequently, the load upon the motor element varies from 1,490 watts to 410 watts, while the load upon the element M is increased from zero to 6,500 watts. The general character of the problem, the treatment of which is covered by the vector diagrams here shown, is exhibited by the rectangular coordinate characteristic curves of Fig. 79 which are plotted against the values of I_2'' from the data given in Table 10.

Fig. 80 exhibits quite clearly the fact that theoretical discussions of circuits, such as those shown in Fig. 76, have a very pertinent bearing upon commercial practice, as the two are entirely analogous.

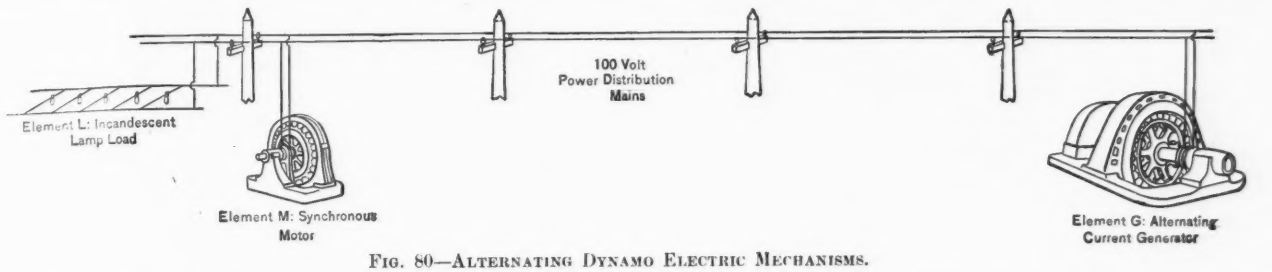


FIG. 80—ALTERNATING DYNAMO ELECTRIC MECHANISMS.

TABLE 9.

DATA PERTAINING TO EXAMPLE 16.

	Ohms. r_2''.	Amperes. I_2''.	Volts E_{2r}.	Volts. E_{2x}.	Volts. E_2.	Amperes. I.	Volts E_{1r}.	Volts. E_{1x}.	Volts. E_1.	Volts E.
a	∞	0	26	97	100	40	10	21	23	84
b	2.50	40	79	61	100	63	16	33	38	100
c	1.25	80	92	39	100	98	25	51	57	118
d	.83	120	96	29	100	136	36	70	79	138
e	.63	160	98	22	100	175	45	89	100	157

TABLE 10.

DATA PERTAINING TO EXAMPLE 16.

	Volts. E.	Volts. E_1.	Volts. E_2.	Volts. I_{1r}.	Volts. E_{1x}.	Volts. E_{2r}.	Volts. E_{2x}.	Amperes. I	Degrees. ϕ_2.	Amperes $I_2{}^a$.	Amperes. $I_2{}^c$.
a	100	27	119	12	25	31	115	48	75	0	48
b	100	37	100	16	33	79	61	63	38	40	40
c	100	48	85	22	43	78	33	83	23	68	34
d	100	57	72	26	51	70	21	99	17	87	29
e	100	64	64	29	57	62	14	112	13	102	25

In connection with this treatment it will be profitable to follow out its application to cases in which it is desired to make an exact determination of the capacity reactance which should be introduced in parallel with a given non-inductive receiving circuit, carrying a given load to obtain at the terminals of the receiving circuit a given potential when the electric pressure developed at the generating station is a known constant. The study of such a problem is, in fact, the study of receiver potential regulation by the introduction of capacity effects or elements requiring leading currents.

Surface Contact Railways in Paris.

A very important extension of electric tramways, worked on the Diatto surface contact system, has just been completed at Paris for the Compagnies de l'Est and de l'Ouest, says *Engineering*. The lines of the former company include the old Romainville line, which has now been extended on the one side to the Opera and on the other up to Montfermeil; while there are branches to Pantin and Bobigny and to Vincennes. The new generating station is at Vitry, and it is intended to use the old stations merely as transformer substations. The lines of the Western company include the old Chatenay-Champ de Mars and the Billancourt-Champ de Mars tramways, and the latter has now been extended to Auteuil. The supply in this case is effected from the Moleneaux station. The current is generated at 5,000 volts on the three-phase system, and conveyed to the substations by lead-covered cables, each of which has in it a conductor for each of the phases. These cables are laid on a bed of sand about eight inches thick, at the bottom of a trench two feet three and one-half inches deep. At the substations the triphase currents are first transformed down in oil-insulated transformers to 350 volts, and are then used to drive rotary converters, supplying continuous currents at 550 volts. In the Diatto system, which has already received a pretty extensive trial at Paris, the studs with which the shoe on the car makes contact are connected to the feeder cable through an automatic switch operated by electromagnets on the car. This switch consists of a soft iron rod floating in mercury. As the car passes over the stud this rod is raised by the attraction of the magnets and closes a carbon contact, which is broken again as the car moves on by the iron falling back by its own weight. The studs are placed at intervals of about 16 feet, so that no contact is broken by the car passing on before the circuit through the next stud has been closed. Arcing is therefore avoided.

MODERN TELEPHONE ENGINEERING—V.

BY KEMPSTER B. MILLER.

There is probably no method of determining the relative activity of any city at different times of the day or on different days, so well as by watching the telephone exchange in that city in operation. For keeping track of their business and being able to handle it to the greatest advantage, telephone companies usually make at frequent intervals what they term "peg counts." These show the total number of calls received and connections made during each of the 24 hours of the day. These results, if plotted in the form of a curve, in which the abscissæ represent time and the ordinates represent total number of calls per hour, show graphically and in a striking way the amount of telephone business being transacted at any given hour. The curves (Fig. 7) show what I believe has never been shown before—that is, peg counts, taken the same day, of two opposition exchanges in the same city. These exchanges have about the same number of subscribers, not far from 6,000. The dotted curve represents the telephone activity in the Bell exchange, while the solid curve represents that of the independent exchange. The rates of the Bell exchange are considerably higher than those of the independent, and from this fact we are enabled to draw several conclusions from the form of the two curves.

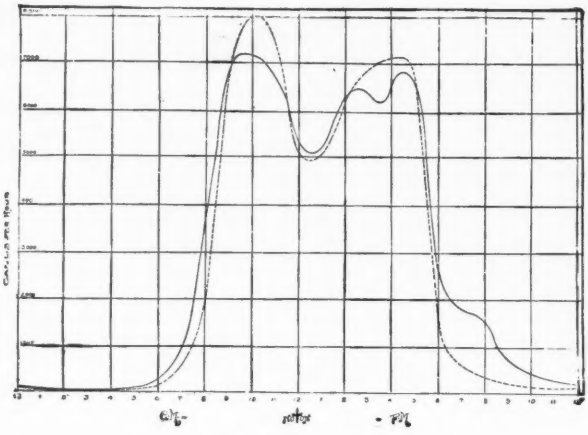


FIG. 7.—LOAD CURVE.

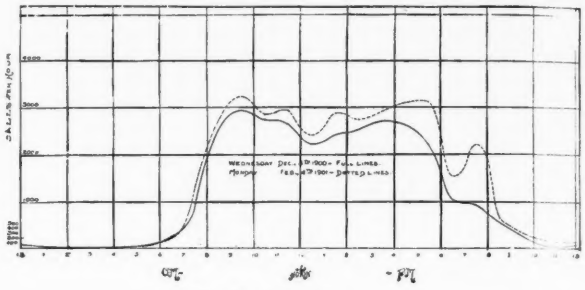


FIG. 8.—LOAD CURVE.

It will be noticed that from twelve at midnight until six o'clock both curves are very low, and gradually fall until three o'clock, after which they slowly rise until six. This shows conclusively that the hour of 3 A. M. is that of least business activity, except, perhaps, in those lines, such as burglary and other allied industries, which seldom require the use of telephone service. From the hour of 6 A. M. each of the curves rises rapidly, corresponding to the awakening of the city, reaching a maximum for the day in the neighborhood of ten o'clock, A. M. They then fall off to a minimum, corresponding to the lunch hour, between twelve and one, and again rise to a second maximum between the

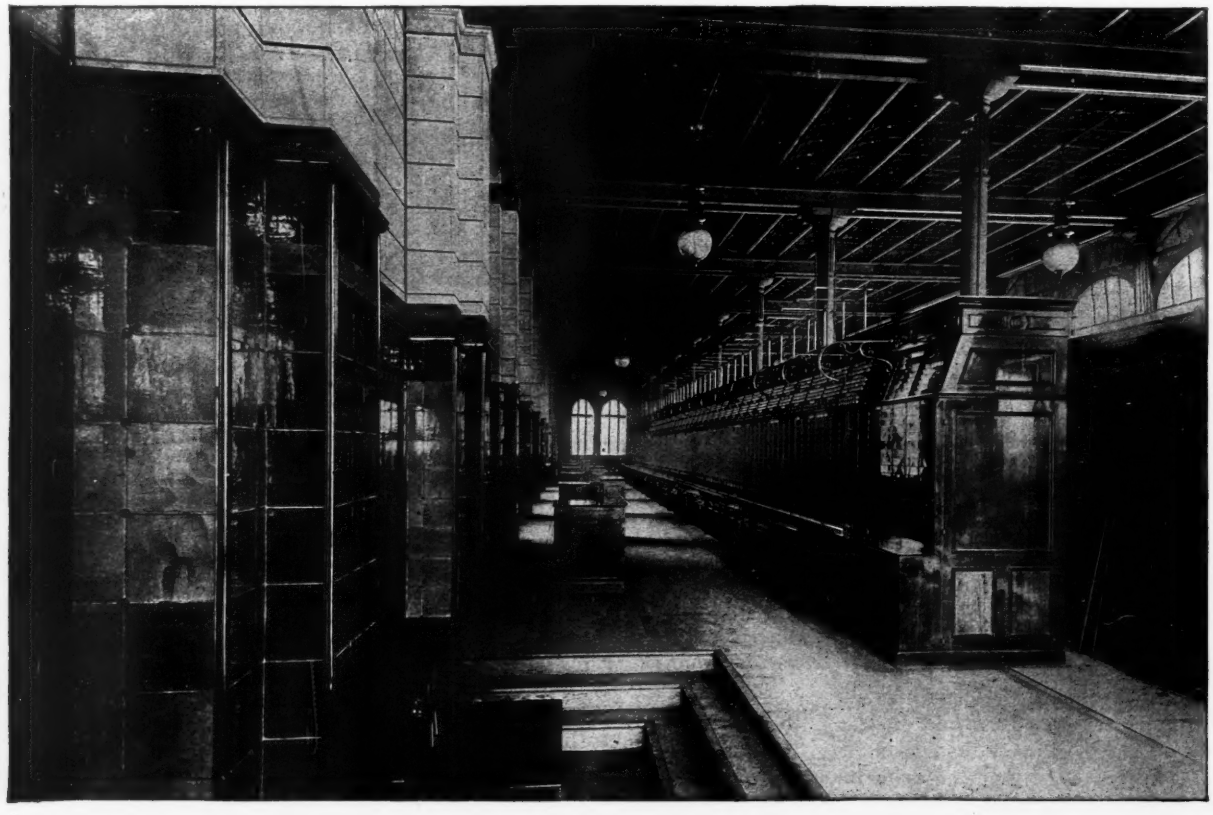


FIG. 9.—THE TELEPHONE EXCHANGE AT PARIS, FRANCE.

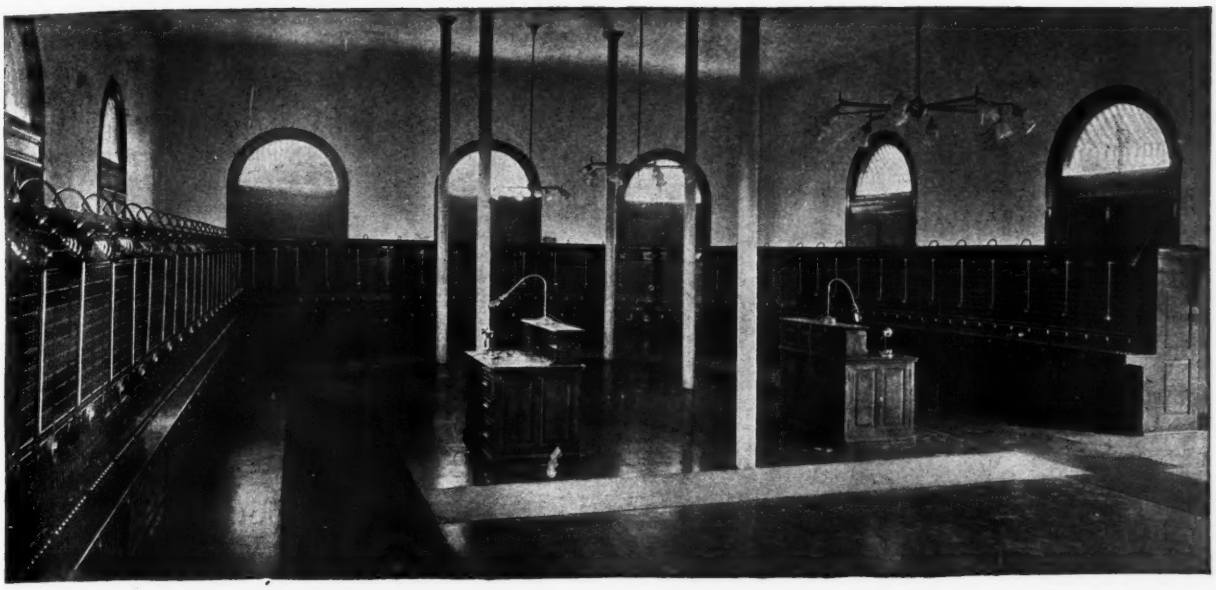


FIG. 10.—THE PITTSBURGH TELEPHONE EXCHANGE.

hours of four and five in the afternoon, after which they rapidly fall during the evening hours. The fact that the independent exchange has cheaper telephones than the other will, perhaps, account for the fact that its subscribers begin work a little earlier in the morning, reach their maximum activity at a little earlier hour, take a little shorter time for lunch, go home a little later in the evening and work a little more all night, all of which facts are indicated by these two curves.

In Fig. 8 I show two curves representing telephonic activity of the same city on two different dates. It will be noticed that the dotted curve, which represents a Monday, shows a greater number of calls than the solid curve, which was taken on a Wednesday. It is usually true that Monday is about the busiest day in the week in telephonic exchanges. It would be interesting to trace the significance of the different humps or characteristics of these curves, but it will be noticed that whatever hump is on one is present, or, at least, suggested, on the other. The pronounced hump on the dotted curve at the extreme right is undoubtedly due to the theatre business between seven and eight in the evening. Probably the reason why this was more pronounced on one curve than on the other was that there was a special attraction, or special set of attractions, in the entertainment line on the particular day on which the curve was taken. Such curves as these have been said by some one to represent the pulse of the city, and I think that the longer one thinks about it the more apt this term appears. Every city has a heart in its telephone exchange, and this heart is throbbing with as great a regularity as that of any living creature.

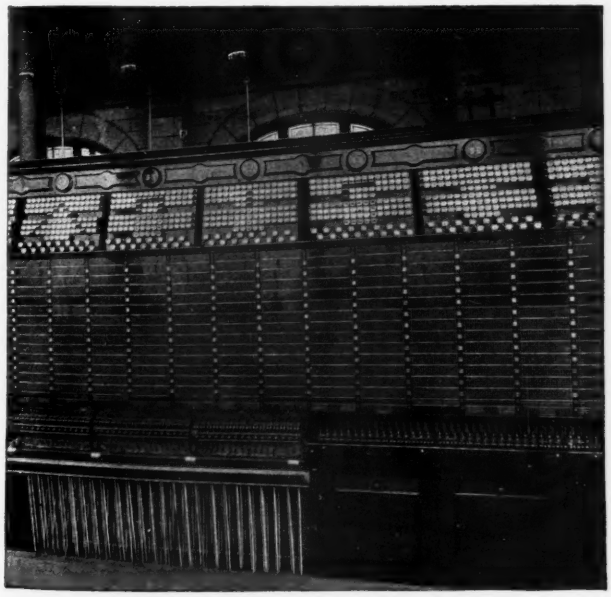


FIG. 11.—FRONT OF PARIS BOARD.

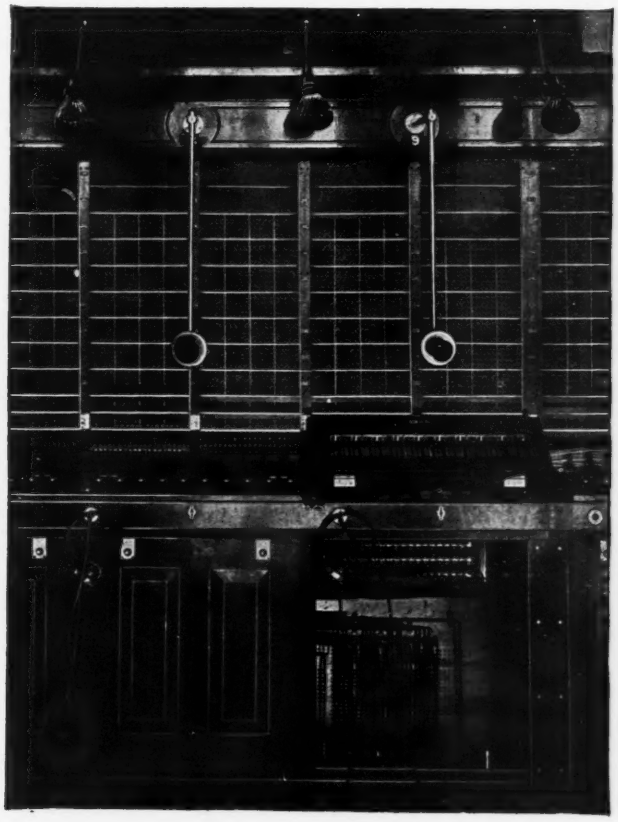


FIG. 12.—FRONT OF A PITTSBURGH SECTION.

I will now, in conclusion, show a number of pictures of telephone exchanges and apparatus which, I think, will be of general interest, and which, perhaps, will make some of the statements which I have made more clear to those not well posted in telephony. My first view in this series (Fig. 9) is that of the interior of the exchange installed by the Western Electric Company at Paris, France. This board is next to the largest in the world, it having a capacity of something like 9,300 lines.

The next view (Fig. 10) is that of the multiple board installed for the Pittsburgh & Allegheny Telephone Company, of Pittsburgh, Pa., by the Kellogg Switchboard and Supply Company. This board is now wired for 4,080 lines and has an ultimate capacity of 6,000. It forms the main office of the Pittsburgh & Allegheny exchange, there being six branch offices located in the various parts of Pittsburgh and Allegheny, all operating in conjunction with the exchange here shown. The total present equipment of these offices is about 7,000 lines.

Fig. 11 shows the front view of one of the sections of the great switchboard at Paris, shown in Fig. 9. In this board mechanical annunciators of the electrically self-restoring type were used, which can be seen at the extreme top of the section. Those signals are automatically restored when the operator inserts a plug into the answering jack, but this arrangement has a marked disadvantage over the more modern form of boards wherein the line signals are located in the immediate vicinity of the answering jacks. With the drops, as shown in this section, the operator had first to look to the top of the section, fix the number of the signal displayed in her mind, and then look down and pick out the corresponding answering jack in which to insert the plug. In the later boards, where the line signal is next to the corresponding answering jack, she is saved this change of vision, and also this mental operation. She simply plugs into the jack next to the signal displayed without any regard to its number.

In Fig. 13 is shown a front view of several of the sections of the Pittsburgh exchange, a complete view of which was just seen, and in Fig. 12 a closer view of one of the sections. Here the multiple jacks are plainly seen in the upper portion of the board, the answering jacks and line signals being shown below. One of the key shelves is raised, showing the wiring of the ringing and listening keys, and also the springs of these keys. Below this one of the front panels is removed, showing some details of the wiring of the connecting rack of the section.

The next view (Fig. 14) is that of the rear of the St. Louis switchboard. The cables leading to the multiple jacks are shown in the upper portion of this picture, and below them the cord racks, the supervisory relays and the running box containing the various line cables are clearly shown.

Fig. 15 is a similar view of the rear sections of the Pittsburgh exchange, a good idea of the multiple cables being afforded.

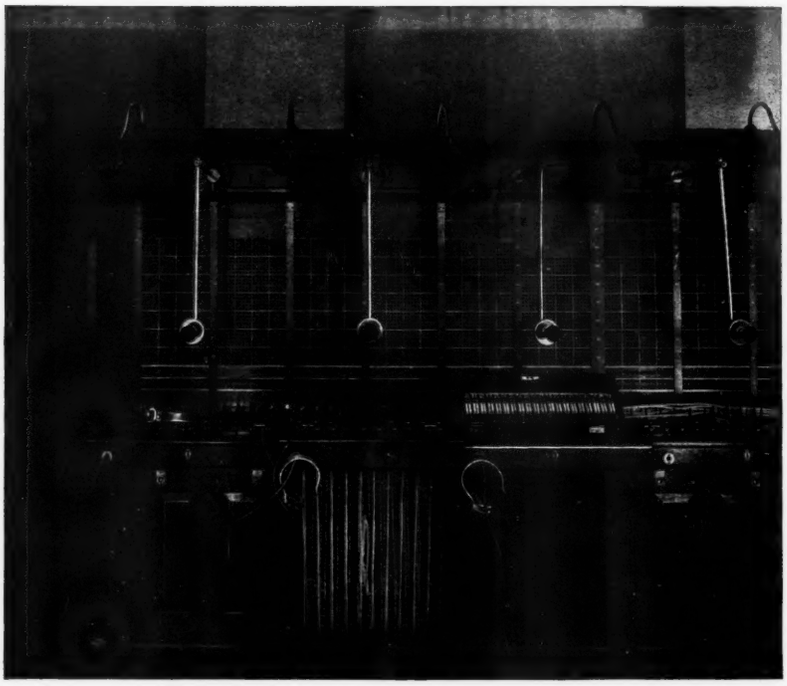


Fig. 13.—Single Section of Front of Pittsburgh Board.

Fig. 16 shows with greater detail the rear of one of the Pittsburgh sections. The multiple cables are seen at the top and below these are the relay boxes, one of which is open, disclosing the supervisory relays at the top and the line relays of that particular position. In the lower portion of the picture is shown the connecting rack, to which all of the wiring of this particular section is led.

In Fig. 17 is shown the turning section of the multiple cables. This is at the end of the switchboard and shows where the multiple cables are turned downward into the running box, where they run along back of the sections, and are joined to their proper answering jacks and signaling circuits on the connecting rack of each section.

In Fig. 18 is shown what might be called the heart and lungs of a telephone exchange. This is the power plant of the Pittsburgh & Allegheny exchange. On the right is seen the power switchboard, which is of marble, and is provided with voltmeters and ammeters, circuit-breakers and all switches necessary for handling the machines and batteries. In the centre of the picture are shown the two ringing machines and on the right the charging machines for charging the storage batteries.

I will now show (Fig. 19) the storage batteries of this same exchange, these comprising 10 cells each of chloride accumulator, each cell being of 800 ampere-hours capacity. The tanks are of wood, lined with lead, and the floor and walls are of tile laid in cement. At the upper left-hand portion of the picture may be seen the heavy copper bus-bars forming the discharge leads of these batteries. These are of solid copper, three inches by one-half inch in thickness.

The next view (Fig. 20) shows the repeating coils of the Pittsburgh & Allegheny system, there being one of these coils for each pair of cords in the entire exchange. These coils are ironclad and are enclosed, as shown, in a practically dust-proof cabinet. It is through these coils that the current from the storage battery is led to the various cord circuits, whence it passes to the lines of connected subscribers to furnish talking current.

No single feature of telephone work has shown greater advancement than that of outside line construction. In place of the overhead wire, so common a few years ago, and still too common, the lines in systems

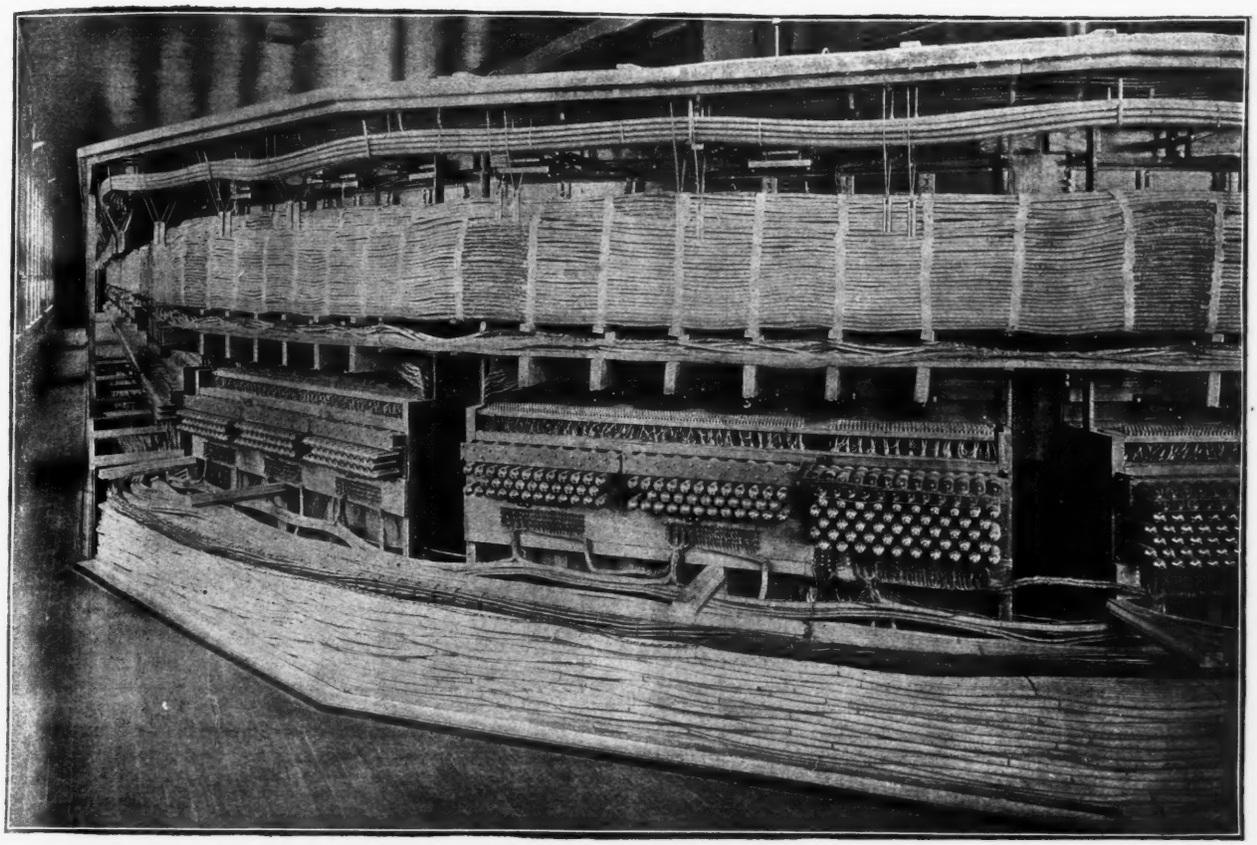


FIG. 14.—REAR OF ST. LOUIS SWITCHBOARD.

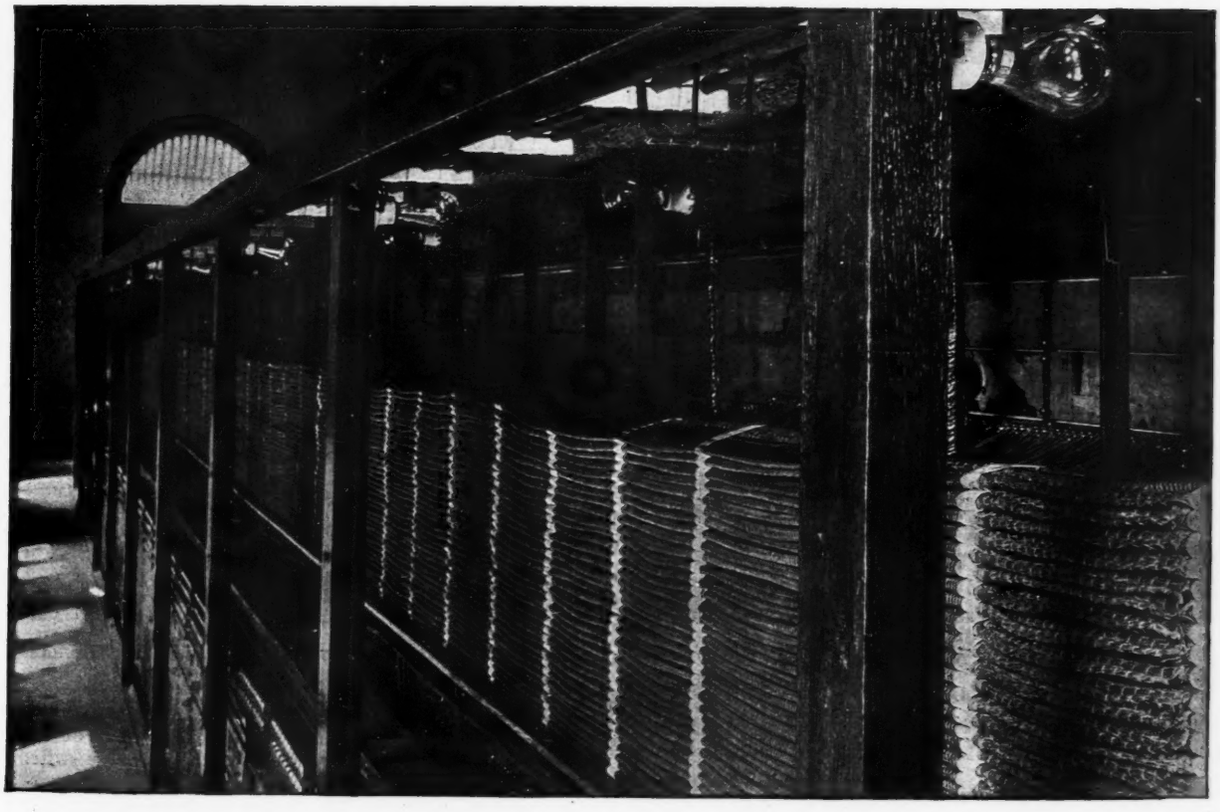


FIG. 15.—REAR OF PITTSBURGH MULTIPLE BOARD.

are being placed underground to a greater and greater extent. My next picture (Fig. 21) illustrates a piece of overhead construction, showing lines as they were about to enter the exchange of the old system at what care and system the cables coming in from the street are led into the cable shaft leading to the exchange room.

The next view (Fig. 23) shows a common method of terminating the lines of various wires of the cables are distributed to insulated contact points on the inside of the boxes. These contact points extend to the outside of the boxes through insulated bushings, and from thence the circuit

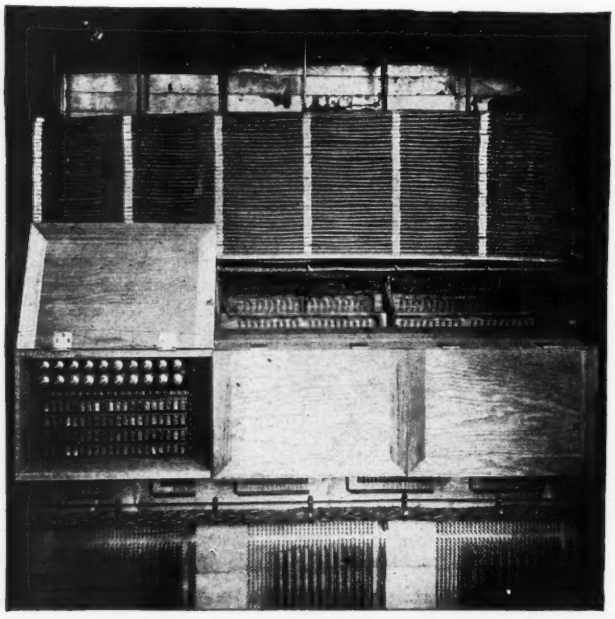


FIG. 16.—REAR OF SINGLE PITTSBURGH SECTION.

FIG. 18.—POWER PLANT IN PITTSBURGH EXCHANGE.

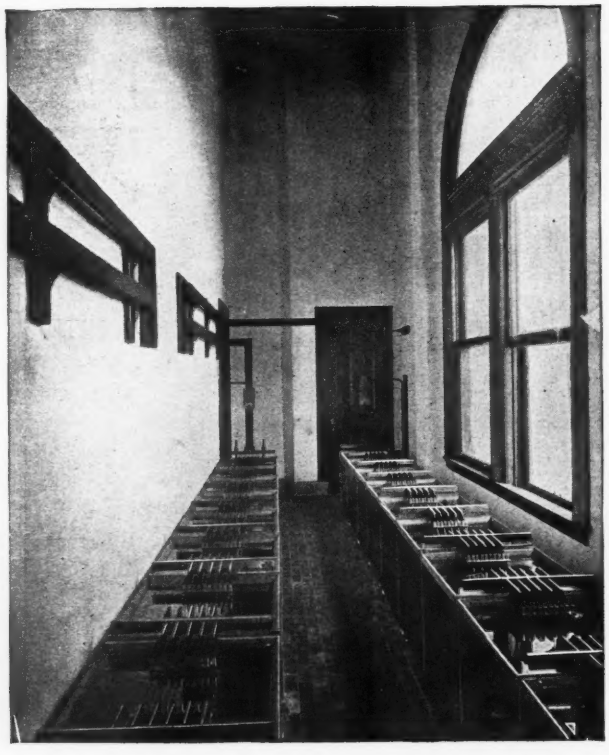


FIG. 19.—STORAGE BATTERIES, PITTSBURGH EXCHANGE.

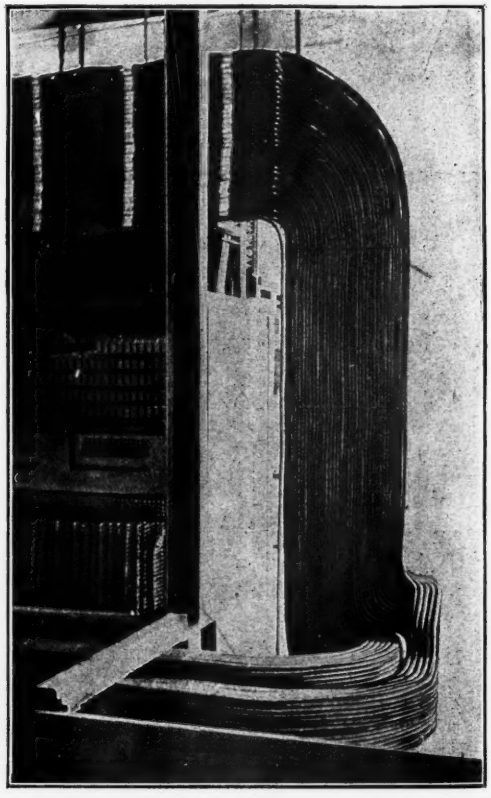


FIG 17.—LINE CONSTRUCTION IN THE ST LOUIS EXCHANGE.

St. Louis, Mo. In marked contrast to this, the next (Fig. 22) is a picture which shows how the subscribers' lines now enter the exchange building in that same St. Louis system. This is a picture of an underground cable vault and shows with telephone exchanges, or rather terminating the outside construction work. The line cables may be seen leading up from the lower part of the picture. These enter the cable heads, which are, in this case, cast-iron boxes hermetically sealed, and the is led through protecting devices, after which they are again arranged into cables which proceed from the top of the cable heads and are then led to the switchboard terminals.

This brings up the subject of distributing boards. A little thought will show

that some means must be provided for distributing the various line wires which enter the exchange to their proper terminals on the switchboard, and to enable such changes to be made in this distribution as required. If such provision were not made and the line cables were run directly to the switchboard, the wires in one 100-pair cable being led, for instance, to the first position, and the wires in the second 100-pair cable to the second position, etc., it would be necessary at any time when a change in a subscriber's number was desired, to open the cable, take out the proper wire and fasten it to one of the other cables leading to the proper section of the board. The changing about of the various line wires from one part of the board to another is a very common occurrence, and to do it in the manner just suggested would be wholly impracticable. In order to provide means for systematically making such changes, recourse is had to what are called distributing boards or frames. These assume a great variety of forms, but the principle upon which they are designed is as follows: In one portion of the distributing board are placed clips suitably arranged, in which the wires of the line cables may terminate. On another portion of the distributing board is arranged another group of clips or connectors in which the separate wires of the switchboard cables may terminate. We thus have all connections from the lines, and also all connections from the switchboard wired in a permanent manner to the various connectors on the respective portions of the distributing board. The gap between the terminals of any pair of wires on the line side of the distributing board, and those of the corresponding pair leading from the switchboard is filled by means of bridle or jumper wires. The distributing board is so arranged that these jumper wires may be run from any pair of connectors on the line side to any pair on the switchboard side, and if the distributing board is a good one, these jumper wires are laid with perfect system and may be changed as often as desired.

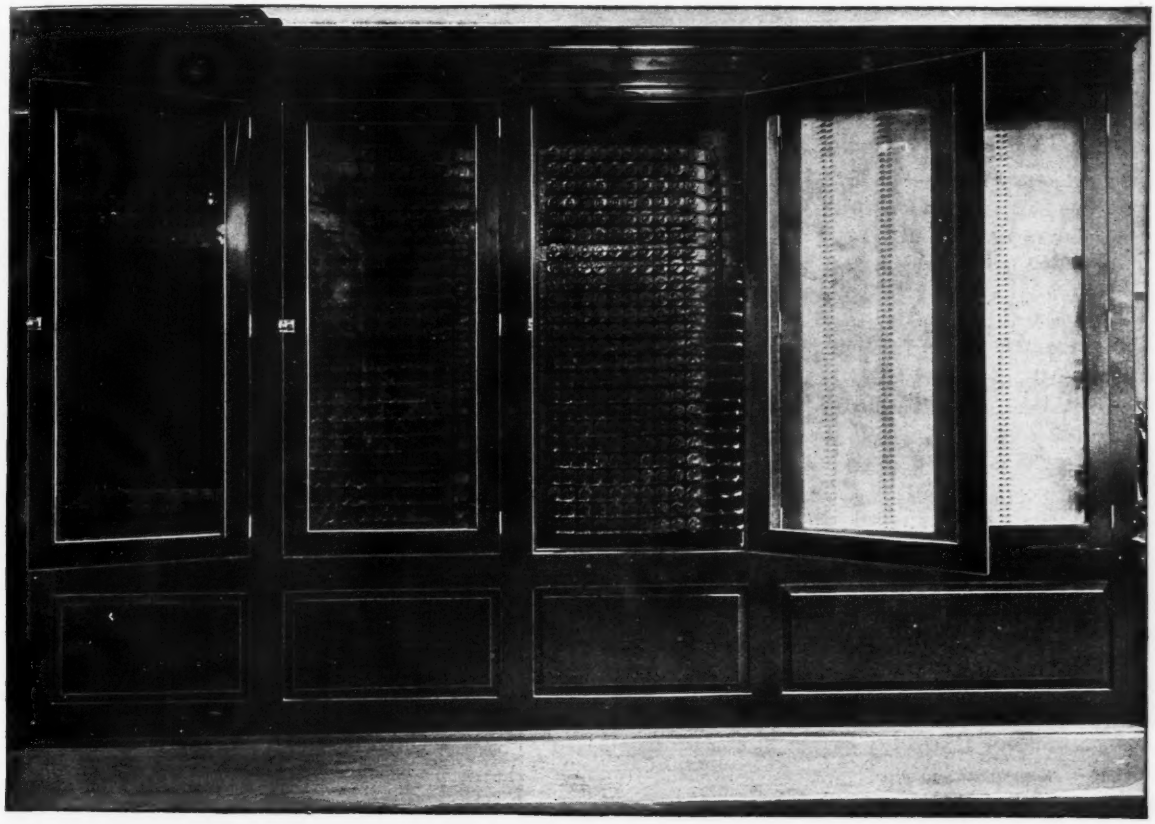


FIG. 20.—REPEATING COIL RACK IN THE PITTSBURGH TELEPHONE EXCHANGE.

FIG. 21.—LINE CONSTRUCTION, OLD ST. LOUIS EXCHANGE.

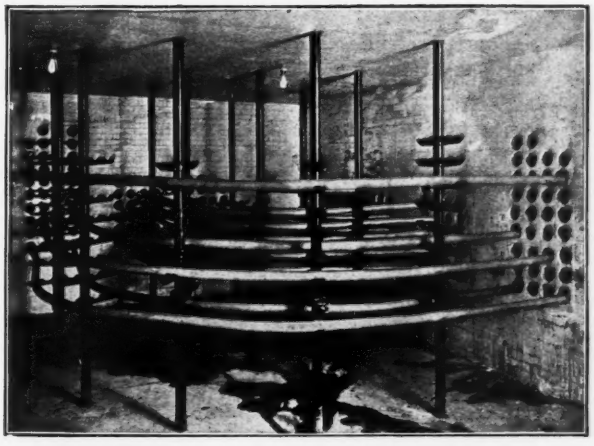


FIG. 22.—VAULT IN THE NEW ST. LOUIS EXCHANGE.

STORAGE BATTERIES IN CENTRAL STATIONS.*

BY AUGUSTUS TREADWELL, JR.

It was with great hesitation that I ventured to accept your invitation, tendered through your distinguished president, to read a paper before a body of men of such demonstrated ability—before men that are not only masters of their own art, but masters of a subject in which I confess myself but a dilettante—but it was with a view of bringing to your attention some facts and data that may perhaps have escaped your attention that I was finally persuaded to prepare the following:

As pointed out by Mr. Charles L. Edgar, in a well-known and oft-quoted paper, the use of storage batteries may be classed under four great heads, *viz.:*

First. To carry the peak of the load at maximum hours.

Second. To carry the entire load at minimum hours.

Third. To act as an equalizer or reservoir.

Fourth. For the equipment of annex stations.

To this, because of modern usage, may be added a fifth subdivision, that is, when used in connection with alternating currents; although the above might more properly be classed under the third or fourth heading.

1. In all systems of lighting, whether it be by gas or electricity, there is a large percentage of the connected load that is used for only a short period of the 24 hours. This period of the maximum demand, as you all know, seldom amounts to less than one and one-half, or lasts longer than four hours per day. Many schemes have been proposed to take care of this load, but none has yet met all the requirements as satisfactorily as have storage batteries. It has been found that storage batteries, when used in this connection, take care, on an average, of at least 50 per cent of the maximum load, and yet this percentage, as you all know, will be but a very small percentage of the total output, measured in kilowatt-hours. If any other plant than a storage battery plant be installed to take care of this large percentage of the maximum load, it will soon be found that the station is running with a very small load factor, and, consequently, with a very low efficiency.

2. To carry the entire load at minimum hours.

Although in the majority of central stations the duration of the minimum load is too short to produce any material saving in either labor or fuel by the shutting down of the engines and generators and the banking of the fires, thus throwing the entire load upon the battery during this period, still there are many times when this may be accomplished with profit.

When a station has a very small motor load it will, perhaps, pay to shut down during this period, thus saving one shift of men and making a decided decrease in the boiler room expenses. In the majority of American stations, however, this period is too short to permit of any such economy. It should be remembered, however, that, although the battery may not carry the entire load every day, it always stands ready to act in that capacity at a moment's notice.

3. It is the use of storage batteries as an equalizer or reservoir that will probably appeal more to engineers than will any of the other uses, important as they may be. The strain caused by the almost hourly question of whether to start dynamos or to stop them, or to change boosters, intensified by the uncertainty as to what the load is going to be at any given time, must be felt to be appreciated.

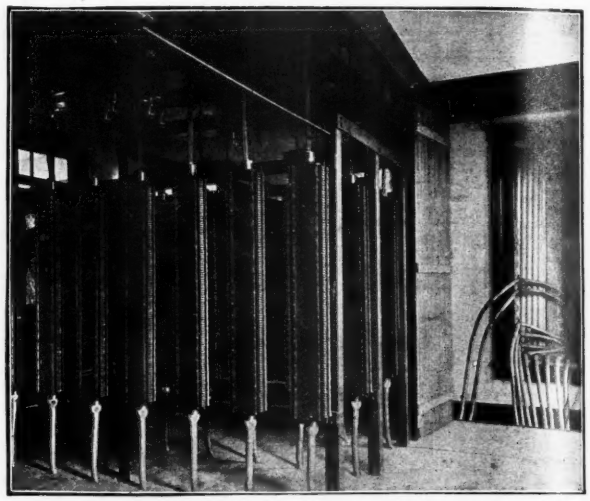


FIG. 23.—CABLE HEADS (See page 691)

The experience of the Philadelphia Edison Company is a case in point. Because of a sudden storm the load was thrown on very quickly and the peak was higher than usual. While other plants were getting their reserve started up, this company was able to give full power immediately.

It is often claimed that heat storage is much more economical, and better in every other way, than storage batteries. While it is almost an impossibility to give absolute figures, still I can state without fear of refutation that heat storage does not form a true reserve, but only relieves the boilers. Accumulators, on the other hand, are a true reserve, delivering the electricity directly, and being much more economical. Moreover, a storage battery, for the same power, does not occupy one-half the space required by heat storage, and costs less, lasts longer, and has less depreciation than those used for either air, steam or water. The pressure, moreover, will be constant, enabling lamps of two and one-half watts per candle to be used, thus representing a saving of at least 20 per cent.

Many engineers claim that the great saving with storage batteries is destroyed by their low efficiency. The majority, however, state that what is lost by the inefficiency of the battery is made up more than fourfold by the better efficiency of the steam plant. In Hamburg the power lost in accumulators is only 1.2 per cent of the average amount of electricity generated during the year. Moreover, experience has proved that the use of accumulators involves the saving of at least 25 per cent in fuel.

4. The advantages to be derived from the use of storage batteries in annex stations are so patent as to require no elaboration on my part. I would simply state, therefore, that where a storage battery annex is installed instead of a separate station, or a new centre of distribution, usually the first cost—and always the maintenance expense—will be found to be much less. Moreover, a high-tension alternating current would probably be employed, thus materially decreasing the line losses.

I can not better illustrate the fifth usage of storage batteries than by reference to the admirable paper read before this body by Professor Robb, in 1899. As you all know, I refer to the paper entitled "Rotary Transformers and Storage Batteries as Related to Long-Distance Transmission."

The main source of power of the Hartford plant is a water power on the Farmington River. Here somewhat over 1,200 electrical horse-power is developed and transmitted, under 10,000 volts pressure, 11 miles to Hartford. Most of this current is then transformed by means of rotaries, and supplies the three-wire, direct-current system. One of the rotaries has a capacity of 400 kilowatts, and is located at the Pearl street station. Two

* Extracts from a paper read before the National Electric Light Association, May 23, 1901.

other rotaries, of a capacity of 250 kilowatts each, are located in the battery substation in State street, in the heart of the business section. At this station is placed a battery of 130 cells, 65 cells in each side of the system. These cells have a capacity of 8,500 ampere-hours at a 15-hour rate, a 1.25-hour rate being allowable if necessary.

Let me quote here Professor Robb's words:

"The advantages of the rotary transformer and the battery system have been very great; what would otherwise have been waste water power has been utilized at the peak of the load at a time when power is most valuable. When operating by steam, the engines have been run at an economical load. During October, 1896, when the battery had not yet been installed, the coal bill amounted to $4,300. For the corresponding month in 1897, the batteries having been installed, the coal bill fell to $2,500, notwithstanding the fact that the output of the plant had increased during the year more than 15 per cent. The regulation of the system is much better with the battery than it could possibly be without it, and the service is much more reliable."

In a very able article by Mr. Alton D. Adams, which appeared in the columns of the *Electrical World and Engineer*, in December, 1899, under the heading of "Storage Batteries and Isolated Plants," the author pointed out a field for central-station batteries that should engage the attention of every engineer present. As every one present knows, the cost for a distribution system is often a large per cent of the cost of the entire central-station equipment. In fact, it is often not only the largest single item in the investment, but larger than all others combined, real estate only being excepted.

If, now, the central-station manager installs a storage battery in the buildings of his large consumers, the load on the distributing system will change from a varying load with the maximum during the evening peak, with the consequent heavy loss of power, to a steady average load during the period of minimum demand. This would, of course, change the entire distributing system to this point. In this connection, however, the cost of the battery has to be considered. However, the saving in operation, together with the saving due to the fact that skilled attendance is no longer required (this being, in fact, accomplished by one of the men about the building, in connection with his various other duties), is so great that they should be carefully considered before deciding on either plan. The above, however, is more of the ideal view than the practical, although the writer has in mind stations where this is being accomplished to-day with profit to the management and the consumer. A large private battery plant is virtually a substation, with this in its favor—that its load is close at hand. The great majority of consumers, however, for reasons patent to every one, are not in a position to install a private battery, and the unequal demands on the generating station must continue and stations must carry a combined capacity of generators and batteries, much larger than required for average.

EXAMPLES OF STORAGE BATTERIES IN CENTRAL-STATION PRACTICE.

Let me now draw your attention to a few prominent examples of storage batteries installed in central stations and isolated plants. I have endeavored with the following examples to illustrate only the smaller stations, in order to emphasize more clearly the economy resulting from the use of batteries. Of course, we all acknowledge the benefits to be derived from the use of batteries in large stations, but many of us are apt to overlook the fact that it is in the small stations that the economy, resulting from the use of batteries, will be most quickly felt.

The battery for the Kansas City Electric Light Company is installed in the downtown station of the company, and consists of 70 cells on each side of the three-wire system. Of these 70 cells, 20 are end cells, and may be cut in or out for regulation. Each cell contains 41 plates, measuring 9 inches by 14½ inches. Each battery has a capacity of 800 ampere-hours at a one-hour rating for 110 volts. Besides regulation, this battery carries the peak of the load for about two hours during the evenings.

At Birkenhead, England, a battery substation has been erected two miles from the main generating station. It contains a battery of cells having a capacity of 750 ampere-hours at a five-hour rate. Motor-driven boosters are also installed. As the load is entirely a residential one the batteries are charged during the day and discharged at night.

A small tramway line has also recently been opened by the company, with a station near the centre of the line. Two 150-kilowatt, four-pole, over-compounded, direct-current generators are installed, with field switches for controlling the amount of compounding. A compound "reversible" booster is also installed, so arranged that it can be used with compound-wound instead of shunt-wound dynamos. A battery of 240 electric storage cells, with a capacity of 630 ampere-hours at a seven-hour rate, is in use, no end cells being required, the use of the booster rendering such cells unnecessary. During the hours of light load the machine boosts up the pressure of the accumulators so that they can supply the line, and later acts in the reverse direction, adding volts, in order to enable the batteries to be charged from the switchboard bus-bar and to take up the peak of the load at the same time.

Perhaps the best example of the small central station is in the modern office building or the apartment house. Let me illustrate a prominent example of each. As an example of the former, let me cite the equipment in the Commercial Cable Building, in New York. This building is wired for 3,500 16-candle-power, 240-volt lamps, and is equipped with six screw-type elevators. The power equipment consists of two six-pole, compound-wound, 150-kilowatt generators, running at 220 revolutions per minute, one 25-horse-power motor-driven booster, and a battery of 120 cells, each cell containing 27 plates, with a capacity of 650 ampere-hours at the one-hour rate. The battery is run in parallel with the generators, from 9 A. M. to 9 P. M., and carries the entire load for the other 12 hours. Unless this battery auxiliary had been installed, it would have been necessary to install a third generating unit; as it is, however, but one generator is run during the day, the other being held as a reserve. In a test conducted by the writer during the period of heaviest demand, in October, 1898, the load varied from 300 amperes on charge to 500 amperes on discharge, yet, during these sudden variations the generator current did not vary 100 amperes, and the lighting voltage remained absolutely constant.

For the latter illustration, I can not find a better plant than that installed in one of the large apartment houses on Lenox avenue, New York city. The building is wired for 1,200 lights, and has in operation one high-speed electric passenger elevator. The generating plant consists of two 45-kilowatt, compound-wound, direct-current generators, operating at 125 volts, and a battery of 60 cells, containing 11 plates to the cell.

Before the installation of the battery, it was found to be impossible to keep the engines in good order because of the great variation in load due to the elevators. The coal consumption at that time was about three tons per day. After the installation of the battery only one generator was found to be necessary; the engines were in better condition, and the local consumption was reduced one-half. Besides this, the saving in oil was a not inconsiderable

item, and the improvement in the lighting service was immediately apparent.

I might thus continue quoting installation after installation, both here and abroad, showing the advantages of storage batteries in central-station practice; but I believe the few instances that I have here given are sufficient to show the numerous advantages that are to be derived from their use.

Wherever the nature of the load is such that large and sudden fluctuations are produced upon the engines and generators, a battery is a necessity if it is desired to operate at any but a very low efficiency. The resultant saving in fuel will soon pay for the first cost of the battery and will be equivalent to a high rate of interest on the investment.

When the load on the system becomes too great for the generators it is unnecessary to put in new boilers, engines and dynamos. The addition will bring about the desired results, besides adding numerous advantages to the system.

The writer has had occasion recently to examine the results of a large number of tests made on storage battery plants in and around New York city. These tests were made by the engineers in charge, and showed a saving in the coal pile, in every case, of at least twenty-seven per cent, in many cases running up as high as thirty-three and one-third per cent. These tests were very carefully conducted and were made under (as nearly as possible) identical conditions, so that the figures given above can be absolutely relied upon.

It is difficult to lay down hard and fast rules concerning the capacity of the battery as compared with the capacity of the stations. The writer has seen a number of rules, and perhaps the best is that given in the London *Electrical Review*, in the issue of December 8, 1899. According to this, the capacity of the first battery should be two and one-half ampere-hours per kilowatt of generating plant laid down, using, of course, the eight-hour rate as the normal rate of discharge. Should any other discharge rate be required, the capacity of the battery should be proportioned. Assuming the capacity at the eight-hour rate at 100 per cent, the capacity at the five-hour rate is but 90 per cent, while the capacity at the two-and-one-half-hour rate is but 73.1 per cent, and at the hour rate the capacity has fallen to 52.25 per cent.

Before closing this paper, permit me to say a few words regarding boosters—so necessary in storage battery installations.

When used, boosters serve a double object in a central station, and the switchboard arrangements in such cases allow both of these objects to be attained.

The first use is that of having a voltage in excess of the bus voltage, in order to get a full charge into the battery. In this case the booster is designed to give the difference in voltage between the battery in a condition of full charge and the bus from which the charging current is derived.

The second use is for establishing a high or intermediate bus pressure.

The installation of the San Francisco Gas and Electric Company has arranged for both of these uses. A pair of 50-kilowatt boosters connected to a single motor has, previously to the installation, been used to provide an auxiliary bus during the hours of light load. After the installation of the battery it was used to charge the battery, and also to maintain the bus.

In the New York Edison batteries, of which there are 13 in the various substations, each has a plain shunt-wound booster of sufficient capacity to charge the battery at normal rates or over. The boosters, however, are rarely used except in cases of emergency for any other purpose than charging the battery, enough end-cell switches having been installed to give four bus pressures at a time, or to be able to regulate on three bus pressures and to charge at the same time.

Sometimes conditions favor an arrangement whereby the use of a booster can be dispensed with, such as in the Adams street station of the Chicago Edison Company, where a battery of 22,400 ampere-hours is charged by means of a pair of 200-kilowatt machines in the Harrison street station over a trunk line between the two stations.

At Hartford the rotary system is so designed that the rotaries can be used to charge direct without the use of a booster and the battery used to supply the necessary regulations by means of an additional cell switch.

The salient features of the reversible booster spoken of in the Birkenhead plant are:

1. The entire doing away with regulating cells, regulating leads and charge and discharge regulating switches.

2. The maintenance of a constant potential, irrespective of the load.

3. The whole arrangement is self-controlled, and is free from any switching arrangements, the whole of the regulation being done entirely by the various windings on the booster.

The machine consists of a motor, generator-dynamo and a reversible controlling generator, the armatures of which are all on the one shaft. The booster is employed in such a way as automatically to keep constant the volts on the circuit during discharge and to raise the bus-bar voltage the requisite amount in order to charge the battery when there is a surplus current from the generators. By this means the booster enables the generator to be kept at practically full load during all times. During a three hours' test of this system, at St. Helen's tramway station, where the load fluctuated violently, the volts were kept constant on the line while the current output of the generators did not vary more than 10 amperes.

In the St. Louis station the plant is shut down from one to five o'clock in the morning, the battery carrying the entire load. In the morning the machinery is started up and the battery charged during the forenoon; it remains connected with the system during the afternoon and takes the peak of the load in the evening.

The interesting features of the curve are the all-night load and the comparatively low peak. The average output for 24 hours is 2,198 amperes, which is about 40 per cent of the maximum load.

In conclusion, it may be stated as a fact that in all stations that have to meet a fluctuating demand, a combined accumulator and steam plant will be found cheaper in first cost, and cheaper and far more satisfactory in the running than would be a steam plant alone for the same work. The same statement holds true wherever water power is to be employed in direct-current or alternating-current systems.

THE DISCUSSION.

Mr. Elmer A. Sperry said: I am very deeply interested in this subject. It comes upon us at a time when there is more general interest in the subject of storage batteries than ever heretofore. The German practice led us, then the English followed, but still American engineers seemed to be unmoved in the storage battery field; but within the last five years we have got the fever and the engineering reports of the last two years will fully justify the statement that the leadership has been transferred to this side of the Atlantic. I believe we shall in this, as in other branches of engineering, justify any prediction that may be indulged in on this line. I believe American engineers are destined to do several things in the line of improving the conditions of central stations by the use of storage batteries. First, I think there is to come (and in the very near future) an improvement in the efficiency of the cell. In three tests that I have had the privilege of being connected with recently, on large central-station batteries that have been in operation for some considerable time—each more than two years—I was interested to find the average charge po-

tential employed throughout the curve, and compare it with the average discharge potential, cell for cell, taken both in the body of the battery and then gradually from the body of the battery up into the end cells. This efficiency, I may state, as the average of three tests, was around 80 per cent; that is, the pressure delivered was practically 80 per cent of the input pressure. This, it seems to me there is reason to believe, will be improved very materially in the near future. I believe we will get storage batteries in the very near future at comparatively low cost per ton which will have even less loss, and I wish to call the attention of the gentlemen present to just what this means. First, it means a considerably decreased requirement in end cells, or the engine capacity in boosters, negative and positive. Secondly, it means that the battery when used as a reservoir will double its sensitiveness, possibly more than double its sensitiveness. What I mean by this is that the battery when used as a reservoir will give a peak with one-half or less than half of the fluctuation of the outside potential, whether occurring through natural causes or artificial causes of the boosters; and, thirdly, it means that when the batteries are applied to a very fluctuating load, such, for instance, as street railway service—and I understand that some of the electric light people are interested in the street railway service to a considerable extent—it means when they are installed that the line potential, especially when they are installed at a distance from the station, can be kept about four times as constant as at present because of the greatly decreased fluctuation necessarily to draw heavily upon the battery.

The other point which I believe is to be accomplished in the near future, from the engineering side of the storage battery, is a more level discharge curve. I think the day of the discharge curve which ranges between wide differences of potential is past. I believe that our discharges, instead of being between practically the larger voltage and a voltage 30 per cent below, will be confined to within 10 per cent, practically all of the electro-motive force of the battery when idle and when fully charged.

The current efficiency of the modern battery is almost 100 per cent. You can put in 100 ampere-hours and can take out 100 ampere-hours. The fact that you put it in at one pressure and take it out at another pressure is where the loss is. A number of engineers working on the problem at the present time are hoping to have that loss, which accounts for the drop in efficiency of the storage battery, entirely removed. I am not speaking of the leaking of the current when the battery is idle. There is no such thing in a storage battery when properly installed. When you put in a certain number of kilowatt-hours, at the end of any reasonable time you will find that number of kilowatt-hours there. I should say six weeks or longer is a reasonable time. A popular notion of the storage battery is that if you do not quickly use the battery after it is charged you will not find any current there; but that is an error. The deterioration of the plates is now reduced to a practical basis, where a number of the storage battery manufacturers are willing to guarantee them for a small percentage, a thing which will be probably the best measure of their understanding of the deterioration of their own goods. I think the practice is different with every maker. I understand that some large batteries in lighting service have gone in under the offer of a guarantee against deterioration, which risk has been borne by the purchaser in the hope that he can maintain the batteries against deterioration for less than the proposed charge.

Mr. Emory—I asked two large manufacturers of batteries if they would guarantee their cells, and they told me they had stopped guaranteeing batteries for railway service.

Mr. Sperry—The use of batteries in the railway service is an unknown factor.

Mr. Emory—They estimated the deterioration at six per cent. That is the reason I ask you what your idea of the percentage is.

Mr. Sperry—You will understand my last remark as applying wholly to the railway service, and not to the lighting service.

Mr. Emory—Do you think six per cent would be a liberal allowance for the maintenance of the battery, wear and tear of plates?

Mr. Sperry—That depends on the service in which the battery is used. It is just as possible to abuse a battery as to abuse a horse.

Mr. Emory—Is not the greatest abuse of the battery incident to its use in the peak of the load?

Mr. Sperry—I think overdraught and trying to charge and discharge too rapidly over the capacity at which the battery is constructed are the causes of much of the wear and tear of the battery.

Mr. Emory—Do you not think it would be well to order cells 50 per cent larger than is really required, so that after a few years of service the battery would not be overworked.

Mr. Sperry—I should think a battery installed with a proper engineering understanding of what it was to be used for would be as good an investment as we have seen in the paper.

Mr. Emory—I have seen very few stations that have had a sufficient overload capacity.

Mr. Sperry—Is not that due to the fact that the demand is greater than they prepared for?

Mr. Emory—Yes, that is true.

Mr. Sperry—That is not the fault of the battery.

Mr. Emory—Is it not good policy to get a battery sufficiently large?

Mr. Sperry—It is good practice with batteries as well as with boilers and engines.

Mr. Charles Blizard—The storage battery people ceased giving a guarantee on their batteries about 18 months ago. It is almost universal modern storage battery practice to put on tanks and cells of a larger capacity than are required for the number of plates installed at the time the battery is put in. Under an arrangement of that kind you can increase the capacity of the battery as the load on the station increases. A good many years ago batteries were put in with tanks filled with plates. A storage battery has a material over-load capacity. As the load increases in the station the storage battery tanks are overworked. This is now being prevented by putting in tanks which will permit an increase of 100 per cent. In relation to the statement made by Mr. Treadwell in his paper as to the loss in a German station of 2.5 per cent, I think that is very materially in excess of the loss in this country. From the experience I have had and reports which I have had, the loss in this country in the average central-station storage battery is a fraction of one per cent—from one-half to three-quarters of one per cent of the total output of the station. A very small part of the current generated goes through the storage battery and there is only a loss on that part put into the battery.

Mr. Charles R. Maunsell—I ask any of the gentlemen present if they can tell what has been the cost of renewing the battery plates in the lighting system. That is, the original cost of the battery and cost of the plates?

Mr. Blizard—The central-station work depends, to a certain extent and within certain limits, on the work done by the storage battery. In some stations batteries are used largely as reservoirs in case of emergency. In other stations they work 50 per cent of the 24 hours, part of the time on low discharge rate and the balance of the time taking the peak. The cost of depreciation depends on the work the battery does. It runs from four per cent to eight per cent, with a fair average at five per cent. In railway service it is less than that.

Mr. W. W. Donaldson—I wish to refer to what Mr. Sperry said about the difference in electro-motive force on the charge and discharge. One of the great troubles in regulation of batteries for central-station work is this great variation. On the discharge, depending whether it is a 10-minute rate or eight-hour rate, the electro-motive force drops decidedly, and when it comes to charging it, of course, goes up. It drops down on discharge to 1.5 volts and on charging rises to 2.7. That makes it necessary either to cut out the end cells or use automatic boosters, etc. This trouble, I have always thought, has come not from a want of active material in the plate itself, but from the fact that that active material did not have sufficient contact surface with its support. I have been making experiments lately and on one particulalar plate that had 4,000 square inches of contact surface, the eight-hour discharge rate was 20 amperes. The surface was increased up to 5,000 square inches, which was exactly an increase of 25 per cent. The eight-hour discharge rate increased proportionately 25 per cent. We gradually discharged it at

higher rates until we finally got to the hour rate, and the increase at this point was 44 per cent, so instead of discharging at 80 amperes, for one hour it discharged at 115 amperes, which was really a very great increase. This shows that the mass of active material was increased 25 per cent, and also that the high discharge was dependent on the contact surface and not on the mass of active material. This increase of active material contact surface not only changed the capacity but straightened out the electro-motive-force curve, so that whereas with the smaller surface the curve fell off gradually, with a larger surface it was almost a straight line for the same period of discharge.

Mr. Sperry—I think that interest is bound to be on the increase rapidly in the matter of storage batteries, and in this connection I would point out the wonderful reservoir and storage capacity of an ordinary storage battery as compared with other forms of storage of power that we frequently meet with. This matter was referred to in Mr. Treadwell's paper. I made some comparative tests a year and a half ago which occasioned a direct comparison between storage batteries, which we all have looked on as being an extremely heavy form of power storage, and compressed air, which latter we all expected to find the very lighest form of power storage. Without going into the details of the experiments, which, by the way, were extremely interesting, we found that the final result was this: Let a ton of the capacity of a storage battery be represented by 100. A ton of Mannesmann tubes, when holding compressed air to the pressure of 2,700 pounds, as used in the Twenty-ninth street cross-town car line of New York, would give, together with the weight of the tube and air (the air weighs 10 pounds per cubic foot at that pressure), was compared. We found that only 0.27 of the power could be obtained from compressed air that could be obtained from the storage battery, a trifle more than one quarter as efficient as a storage battery, and we are used to thinking of the storage battery as being extremely heavy. This 0.27 of the power was only obtainable when the air was reheated and expanded through two series of cylinders at considerable cost and using apparatus of very large weight as compared with the electric motor which would be required to utilize the same energy from storage batteries. I think we should revise our ideas of the storage battery as a reservoir of power. It is really the lightest thing we have to-day.

President Cahoon—I am glad you brought that point out, Mr. Sperry, because there has been a great misunderstanding of that feature of the storage battery.

Mr. Richard Emory—I ask Mr. Sperry whether it would not be desirable in an ordinary battery for railway work to have it specially designed for the purpose it is to be put to, in regard to the quick discharge of the battery. For instance, suppose you were going to use the battery in a railway power plant where cars are run all night and you need the storage battery for four or five hours' use at night, instead of for the high peak maximum load, would it not be better to have a battery designed for that purpose?

Mr. Sperry—I should say not. I should say that a problem of that kind, placed in the hands of an experienced engineer, would result in this state of facts—he would put in a battery which, from the outset, would probably be in excess of the present demand. We find the storage battery to have certain peculiarities. When discharged for a long period of time, for instance, eight hours, it will yield considerably more power in kilowatt-hours than when discharged at a rapid rate for a short time. Any modern battery on a short rate will deliver comparatively an enormous quantity of energy even when fully discharged in less than one hour, and, in that particular, the battery is the most astonishing reservoir, because it is capable not only of delivering a whole station load and more in an hour, if you choose to have a battery of that capacity, but it will do that with a practically constant pressure; whereas in other forms of storage of power with which engineers are familiar—heat, compressed air, etc.—there is a constantly dropping curve until the thing is run out. A storage battery throughout its entire capacity delivers energy on a level line, which is very level as compared with the zero line. Take a battery curve, and we see it starts in here (indicating), and droops down. When we look at the curve we should look to see where the zero line is. It is down here (indicating). So, although it is drooping, considered in connection with a rectangle of power, we see that all the capacity taken from a storage battery is practically on a dead level.

Electric Lighting in Japan.

For some time past small corporations for electric lighting have been formed in considerable numbers throughout the middle and western part of the United States, and the art of electric lighting seems to have taken an unusual impetus within the last year or so. People are rapidly becoming convinced of the practical utility of small electric lighting plants and are as rapidly discarding the antiquated methods formerly in use. Similar conditions prevail to a certain extent abroad, and in Japan there is considerable activity in this field.

The latest Japanese plant to be constructed is the one at Nagoya, which city is situated half-way between the cities of Kobe on the south and Yokohama at the north. The plant in question has a capacity of 300 kilowatts and produces 60-cycle, 2,300-volt, two-phase current, generated by General Electric apparatus direct-coupled to McIntosh & Seymour engines, which, in turn, are operated by three Babcock & Wilcox boilers of 175 horse-power each. The engines, which are of the tandem compound condensing type, take steam at a pressure of 125 pounds, the cylinders measuring 16 and 30 by 32 inches. All the condensing and pumping gear is of the Worthington pattern and is fitted with Crane valves, the uptake from the boilers being supplied with a Broomell-Schmidt economizer. A 10-ton hand traveling crane is operated in the generator room. The exciter is mounted on an extension of the generator armature shaft. The entire plant was designed by the engineering department of the Yokohama office of the Flint, Eddy & American Trading Company, of New York city.

This brief description of the Nagoya plant may be taken as practically typical of all the plants for municipal lighting throughout the island. Other similar systems are situated in Kioto, Osaka, Shinegawa, Kanagawa, Tokio, Kobe and Yokohama, the last-named being operated by the Yokohama Union Electric Light Company. In Kagashima there is a 150-kilowatt, three-phase plant, power for which is furnished by a Pelton water-wheel, belted to the generators. The fall which operates this wheel is said to have an 80-foot head. In Nagasaki a somewhat different condition prevails, there being one or two isolated plants in that city, but none for illuminating the streets or for public supply as is the case with the other places mentioned.

The tendency throughout the Island Empire seems to be toward establishing central stations which shall combine facilities for furnishing electric light, power for transmission and current for traction purposes. There are numerous rice factories and paper mills scattered throughout the islands, all of which can be very reasonably operated by means of water-power generated electric current, and the surplus used for operating lighting systems in small towns in the vicinity of the centres where such mills and factories are located. In brief, it may be said that polyphase currents for power purposes, and systems using rotaries and direct-current motors in street railway work, are meeting with considerable favor in Japan. There is but small doubt that development along these lines will be as rapid as the local conditions permit. No foreign capital whatever is invested in Japan in the industries dependent upon electric power. This is exactly an opposite condition to that which obtains in China. In China those of the natives who have capital are pessimistic and afraid to risk it, so that any enterprise of importance is compelled to be conducted by aliens.

Improvements and additions are being rapidly made throughout the islands in all of the industries mentioned and satisfactory progress has been accomplished in almost every line. It is not believed by those who are thoroughly familiar with the situation that development in any one branch of electrical enterprise will advance more rapidly than in others, inasmuch as the demands of the people and the local conditions are such that diversity in the applications of electricity to commerce is necessary.

Second Report of the National Electric Light Association's Committee on the Photometric Value of Arc Lamps—I.*

This committee is composed of Henry L. Doherty, chairman, Professor W. E. Goldsborough and J. Q. Brown. As was the case last year, the report is one of progress, the various investigations outlined by the committee not being as yet completed. The report opens with an acknowledgment of the uniform courtesy that has been shown by the various manufacturers of arc lamps and carbons in placing at the disposal of the committee the materials needed for the tests. Practically all American makers of lamps and carbons have assisted the committee by furnishing samples of their output for test. The committee calls attention to the growing importance of the enclosed arc as an artificial illuminant, and the need of an accurate knowledge of its performance.

The tests have been carried out for the committee in the photometric laboratories of Purdue University. The committee expresses its great obligation to the authorities of the University for the use of its laboratories and equipment, and for the power facilities so essential to the conduct of the tests.

The bulk of the report deals with the life and efficiency of commercial brands of enclosed arc carbons, although the questions of steadiness of operation in lamps and the photometric values of series direct and alternating-current enclosed arcs are given some attention.

* Abstract prepared by Professor C. P. Matthews, photometrist of the committee.

For the testing of the arc light carbons a special photometric equipment has been designed and installed by Professor C. P. Matthews. Mr. Paul B. Sawyer has assisted him in the work through the year. Acknowledgment is also made to Messrs. Winter, Hardwicke, Le Fever, McBroom and Watjen, members of the graduating class at Purdue University, for their assistance in various parts of the work.

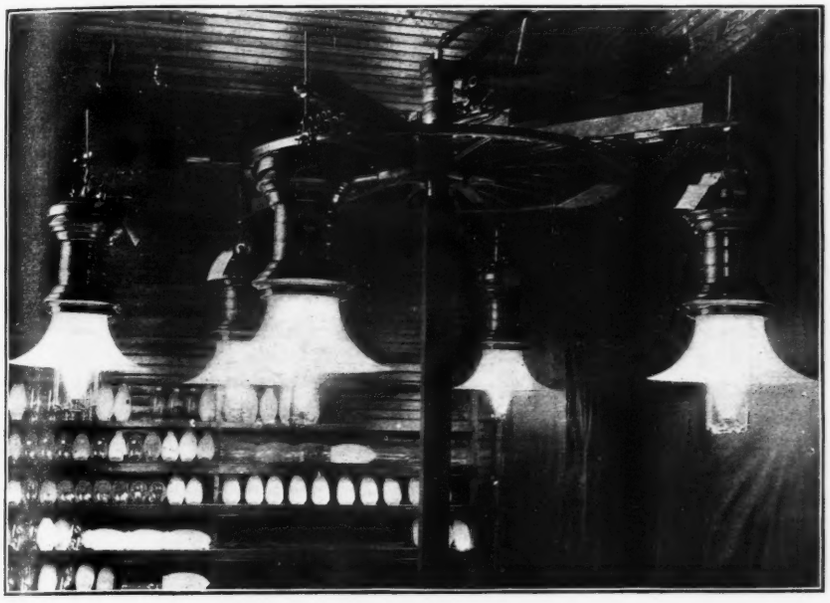


FIG. 1.—SUPPORT FOR LAMPS.

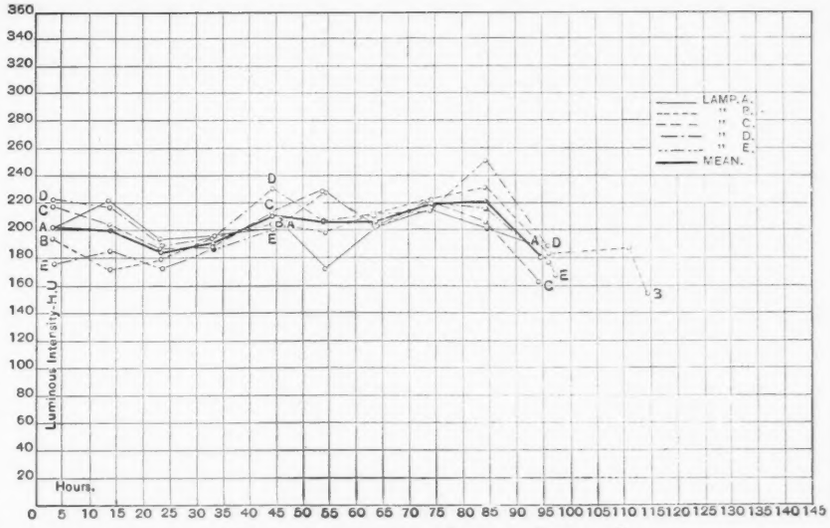


FIG. 2.—INTENSITY LIFE CURVES—CARBONS I.

PROFESSOR MATTHEWS'S REPORT.

"Curves of the distribution of luminous intensity, such as those given in last year's report, are obtained by what may be called the step-by-step method. That is to say, the mirrors are moved stepwise about the source until the complete distribution of intensity in a vertical plane has been obtained. In each position of the mirrors, it is necessary to take from 15 to 25 settings in order to get a good mean. To secure these settings, to make the subsequent calculations and finally the plot, and integrate the necessary curves for a single lamp require the best part of a day. Now, a test upon enclosed arc light carbons, to be in any degree representative, must be the combined result of measurements made upon a number of samples from each brand. Such measurements should be made at intervals of 10 hours, say, throughout the life of the carbons. It becomes at once evident that to apply the stepwise method to an undertaking of this kind would be a well-nigh endless task. I therefore set out to develop and install an apparatus which should give at each photometer setting a value of either the mean spherical or mean hemispherical intensity, as might be desired. The difficulties encountered in the perfection of this method were frequent and oftentimes annoying. When, finally, the sources of error were taken care of, all the constants determined and the method in successful operation, more than half the available time for testing had elapsed. Notwithstanding this, it is doubtful if the results could have been obtained by the slower method in time for presentation here, and one has the satisfaction of feeling that the apparatus is now in working order for expediting further work on arc light photometry.

"A detailed description of this apparatus, with the theory of its operation and with due acknowledgment to my sources of aid, will be given elsewhere.

"However, attention may be called to one feature of the apparatus which has proved to be of great convenience. As shown in Fig. 1, this consists of a wheel with six radial arms, the whole being mounted so as to turn in a horizontal plane. Six lamps may be suspended from the arms, provision being made to adjust the height of the lamp accurately by a suitable turn-buckle. To test a lamp at any period of its life it is only necessary to turn the wheel until the lamp is thrown into its proper position with reference to the mirror system. After closing the black

curtains so as to cut out all extraneous light, the operator can proceed with the measurements. These finished, another lamp is turned into place and the operations repeated. Thus, during the 100 or more hours of their life, the lamps burn quite unmolested. They are tested as often as may be desired and always in the same position with respect to the photometer system. I am confident that in no other way can consistent results be obtained in an investigation of the life performance of enclosed arcs."

After certain preliminary runs to determine the efficiency of the method employed, preparations were made to test samples of five brands of carbons for enclosed arc lighting, these brands being well known and obtainable in the open markets of to-day. The samples represent the product of three American and two European manufacturers.

The carbons were burned in six General Electric 110-volt alternating-current lamps, provided with opalescent inner globes and shades. Of these lamps, five were fitted with the particular brand of carbons to be tested, the sixth lamp being held in reserve lest accident or poor operations should require a substitution. Experience showed, in one or two cases, the wisdom of this precaution. The lamps were suspended from the radial arms of the wheel shown in the foregoing figure. In this position the lamps ran out the life of one trimming. With few exceptions, the only stops were at the close of the laboratory day. Counting all interruptions, the average run was about eight hours. Not infrequently a steady run of 12 hours occurred. These conditions are probably somewhat better, and certainly no worse, than the average conditions of practice. The carbon life shown in the following results seems to corroborate this statement, as the life usually claimed for lamps of this type is 80 to 100 hours. It may be well to note just here that the duration of burning in these lamps is limited by the allowable range of descent of the upper carbon holder. This range is a fixed quantity. The life, t, on one trimming may, therefore, be expressed by the simple formula,

$$t = \frac{l_o}{r_u + r_l}$$

where l_o is the fixed range referred to and r_u, r_l the respective rates of burning of the upper and lower carbons. The life, clearly, will be a maximum for that case in which the sum of these rates is a minimum.

A lamp fitted with a shade is, in itself, an intimation that only the downward flux of light is of value. The logical basis of comparison in such cases is the mean hemispherical intensity, or, if desired, the downward flux of light which is 2π, the mean hemispherical intensity. In the following carbon tests, the mean hemispherical intensity is the quantity determined. In the curves it will be found plotted as an ordinate against time as an abscissa.

In what follows, the brands of carbons will be designated by Roman numerals in the order of the tests, while the lamps will be referred to as A, B, etc. The upper carbon in all the tests was cored, the lower carbon solid.

Carbons I—The results of the first test are to be found in Fig. 2, which shows the life curves of the individual lamps in light lines and the mean performance of the five lamps in the heavy line. We note here that the trend of the mean curve is, in the main, upward. After 85 hours' burning, these carbons show 10 per cent better performance than at the start. Lamp B distanced its companions by showing a life of 114 hours. On the third, fourth, seventh and eighth tests the points are quite close together; on the other tests there is more or less divergence. Why this difference? The use of an apparatus for recording the changes in the arc length in lamps such as these has convinced me that these differences are due, in a large measure, to changes in the arc length. Now, the time between successive feedings is, in a well-regulated lamp, an interval considerably longer than that required for a test. During this interval between feedings, the arc tends to grow steadily longer. It has been shown by Blondel and by Ayrton that the luminous intensity of an arc at constant current is dependent in a very important way on the arc length. It seems clear, then, that tests such as those described here might at one time find the arcs of approximately the same length, and

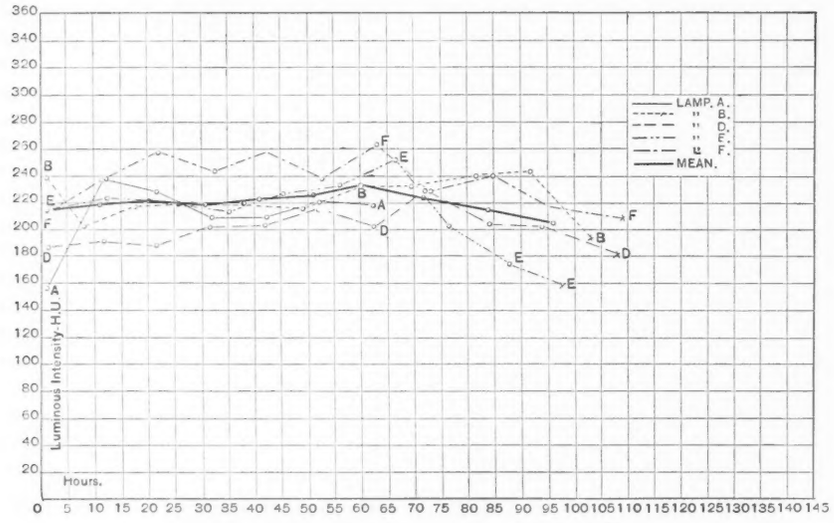


FIG. 3.—INTENSITY LIFE CURVES—CARBONS II.

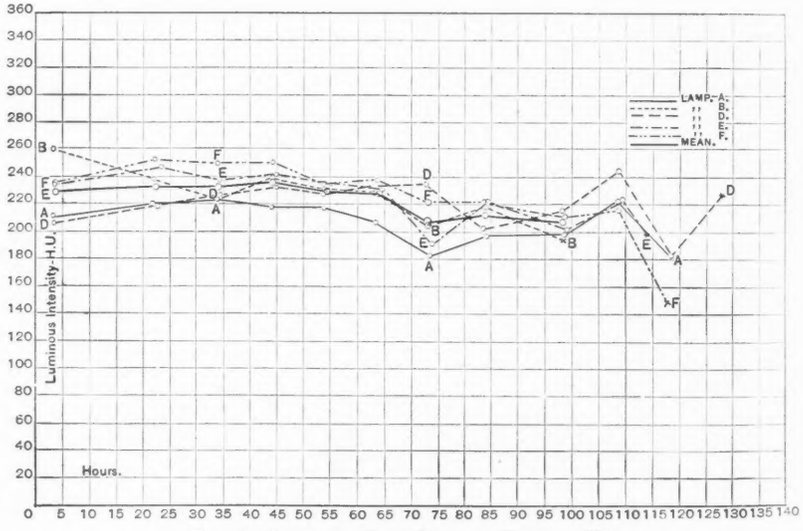


FIG. 4.—INTENSITY LIFE CURVES—CARBONS III.

at another time differing considerably in length. Lack of homogeneity in either upper or lower carbon might also have an effect. It is evident that any constant difference in the carbons or in the transparency of the inner globes would be made manifest by a permanent separation of the life curves.

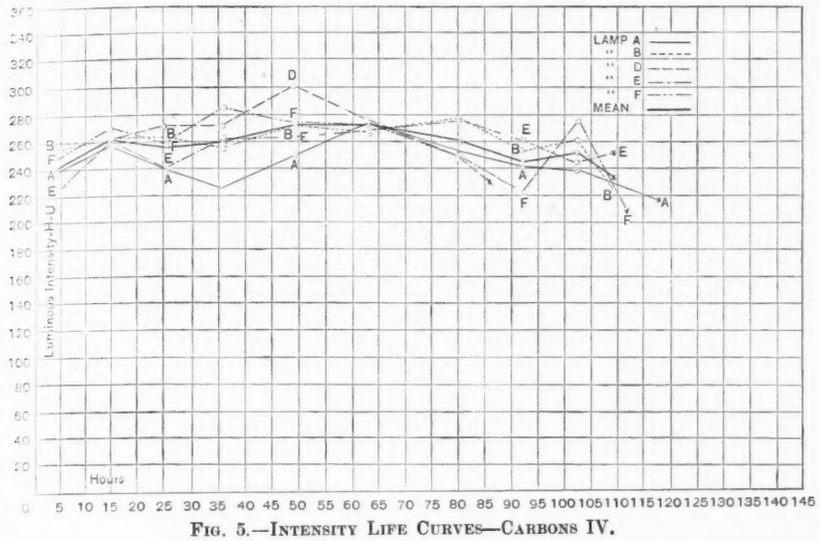


FIG. 5.—INTENSITY LIFE CURVES—CARBONS IV.

While the length of these curves indicates the life of the carbons and the mean ordinate their light value, these quantities alone are not a sufficient measure of the worth of the carbon. The area between the curves and the X-axis is an important basis of comparison. This area has been found for each test. It is measured in Hefner-unit-hours. For carbons I, this quantity is 20,200 or 202 hekto-Hefner-hours. The mean intensity is 202 H. U. and the life on one trimming, 100 hours.

Carbons II—The results for this set of carbons are to be found in Fig. 3. The mean life is practically 99 hours. However, lamp A showed the brief life of 62.5 hours. There must have been some imperfection in the fit of the gas cap on this lamp, although every precaution was taken to secure impartial treatment in this, as in every other respect. If it is justifiable to exclude A, we find a life of 107.9 hours. The Hefner-unit-hours rise in such case to 23,800. The performance of A indicates that the life of an enclosed arc may be seriously curtailed by causes not easily detected.

The mean curve in this test rises to a maximum at 60 hours' life. Lamp F shows a somewhat remarkable performance, both as regards intensity and life. A mean intensity of 238 H. U. is maintained throughout 111 hours, or a yield of 264 hekto-Hefner-hours, which is about double the yield of A.

Carbons III—The records for this set of carbons are to be found in Fig. 4. As regards life, these carbons show a noteworthy performance. The mean life is 115.6 hours, and the maximum life 129 hours. The mean curve does not show the tendency to rise shown in the case of carbons I, although as a whole it lies high.

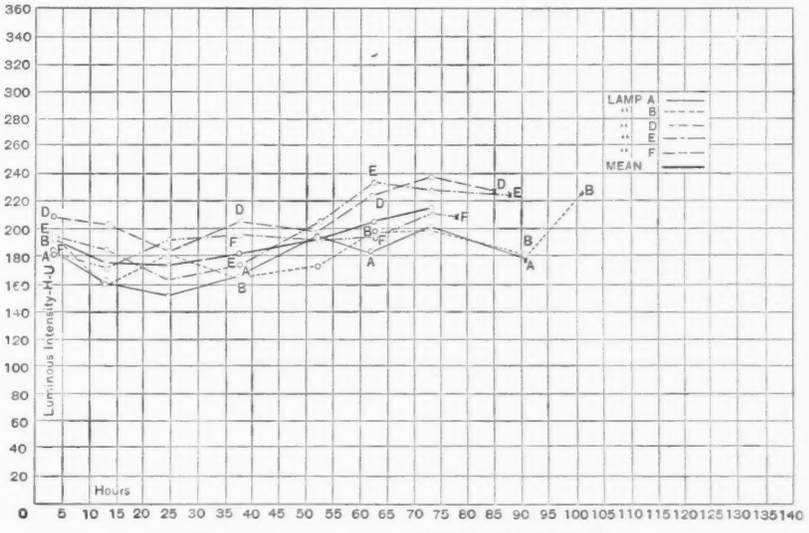


FIG. 6.—INTENSITY LIFE CURVES—CARBONS V.

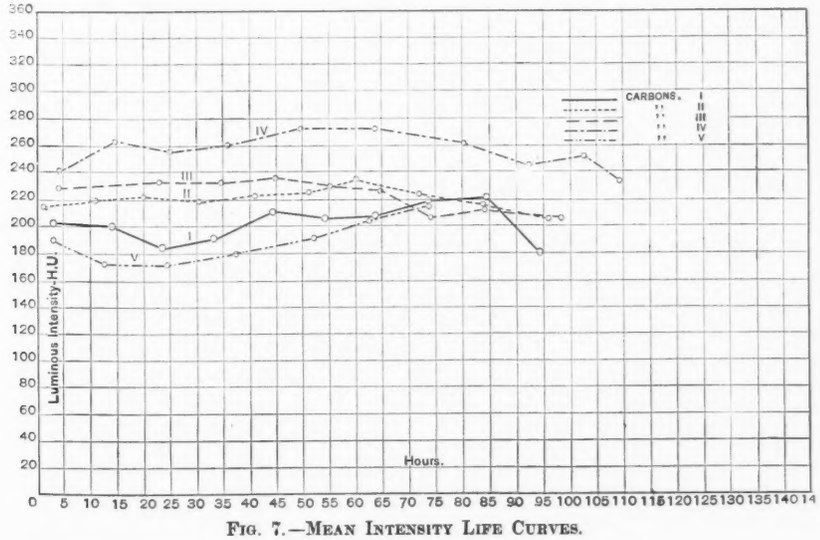


FIG. 7.—MEAN INTENSITY LIFE CURVES.

By weight the per cent ash and dust is about the same. An inspection of the inner globes after the tests showed that the deposit near the base of the globe in case III was darker, that is, contained more carbon dust than in case I. This is, in my opinion, the cause of the drooping tendency to be seen in the mean curve of carbons III after 45 hours. In this connection, it is important to note that the number of extinctions in these tests was somewhat greater than in the case of carbons I and II. The carbon dust is due, in large part, to the pounding or chattering of the carbons at the start.

These carbons show a mean performance of 252 hekto-Hefner-hours.

Carbons IV—The performance of these carbons is well shown in the curves in

Fig. 5. The contour of the mean curve is smooth and represents in an excellent manner the life behavior of a lamp of this type. The arc appears beneath the edge of the shade at about 45 hours, giving a maximum luminous intensity at about 55 hours. The third maximum point at 100 hours was obtained in some of the other cases and will, no doubt, always be present when the coating at the base of the globe is not too dense.

Carbons V—Fig. 6 shows the life history of these carbons. The luminous intensity is low and the life rather brief. The core of the upper carbon seemed to be of high conductivity but of too loose structure, as it fell out in considerable quantities because of the pounding of the carbons, and collected around the base of the lower carbon. The arc was very long and well centred at the start, but not particularly luminous. The materials in the core are such as to lower the luminous intensity with little, if any, gain in steadiness of operation. The very considerable rise in the intensity curve shows that the ash on the globe is not excessive. The gain in the weights of the globes confirms this conclusion. The mean life is 85.6, the mean luminous intensity is 196 and their product 16,600.

It is of interest to plot on one sheet the mean curves of these various life histories. Fig. 7 shows the result. We may compare these five brands of carbons in three different ways; *viz.:* on a basis of luminous intensity, on a basis of life and on a basis of the product of intensity and life. Arranging the carbons in order of excellence, the best first, we have:

Intensity.	Life.	Intensity × Life
IV	III	IV
III	II*	III
II	IV	II
I	I*	I
V	V	V

* If A be included in carbons II, the starred values will be interchanged.

It is of interest to note that after 75 hours burning, carbons I, II, III and V gave approximately the same luminous intensity, and also that the trend of all the curves is, in the main, upward. Carbons IV maintain a distinct lead throughout their life.

A partial summary of the results is given in the following table:

TABLE I.

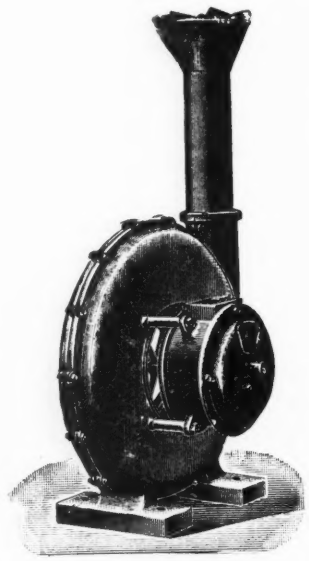
	1	2	3	4	5
Total consumption, inches	6.19	6.3	6.16	6.3	6.32
Consumption ratio	16.4%	16.5%	5.1%	8.4%	.....
Clearance	.0094	.010	.0093	.0079	.0151
Number of extinctions	11	14	16	14	11
Average run	9.3	7.4	7.09	7.3	7.74
Life on one trim	100.1	98.8	115.6	105.2	85.6
Luminous intensity	202	218	222	259	196
Hefner-unit-hours	20,200	21,500	25,200	27,500	16 600
Hefner-unit-hours per inch	3,263	3,540	4 089	4,360	2,609

Trans-Continental Automobile Trip.

Mr. Alexander Winton, of Cleveland, Ohio, left San Francisco on May 20, carrying a packet from General Shafter for Lieutenant-General Miles, in Washington, D. C., his object being to establish an automobile road record between San Francisco and New York *via* Chicago.

Electric Sirens.

The accompanying illustration represents an ingenious apparatus which has been placed upon the Italian market by a manufacturer in that country. It is intended to take the place of steam whistles



An Electric Siren.

and other such alarm apparatus. It consists of a centrifugal blower direct-coupled with an enclosed motor (either direct or alternating current) and carrying at the top of a short vertical pipe the usual siren disk. The apparatus, of course, may be operated from a great distance if this is desired.

The American Society of Mechanical Engineers.

The forty-third meeting of the American Society of Mechanical Engineers will be held at the Plankington House in Milwaukee, Wis., May 28 to 31, inclusive. The meetings will be held in the Arcade on the second floor, and a large and interesting programme of attractions has been provided. The usual papers, which from the programme give every indication of continuing the high professional status of the addresses presented on such occasions, will be read. Members or others desiring to attend should communicate with Mr. F. R. Hutton, secretary, at 12 West Thirty-first street, New York city.

The Edison Storage Battery Company.

Mr. Thomas A. Edison has, with Messrs. Herman E. Dick, Walter S. Mallory and William E. Gilmore, of Orange, N. J., formed a company to manufacture his new storage battery. It is thought that the new company, which has a capital stock of $1,000,000, will be the parent or controlling body of a number of similar organizations to be organized later for the same purpose. The factory will be located in Mr. Edison's Glen Ridge, N. J., present factory, which will be enlarged and improved for the purpose.

Automobile Ambulances in Paris.

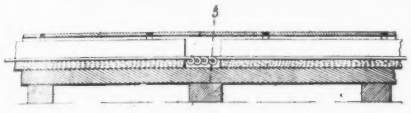
It is reported that the Paris, France, Department of Charities is experimenting with automobile ambulances and that a recommendation is soon to be presented to the municipal council of Paris asking that either the whole or part of the ambulance service of the Department be changed from horse to mechanical traction. If the present trials prove satisfactory the Department will ask that every time ambulances are added to its equipment automobiles be procured.

Railway Franchises in Cuba.

General Josè Lacret y Morlot, a member of the Constitutional Convention of Cuba, has taken up the matter of opposition to securing railroad franchises in the island of Cuba by the Cuba Company, of which Sir William C. Van Horne, of Canada, is the president. Strong New York interests are said to be back of General Lacret. Sir William's company—the Cuba Company— was organized about a year ago, its president being also president of the board of directors of the Canadian Pacific Railway. The company is capitalized at $8,000,000 and expects to increase this. It has now about 3,000 men at work on its railroad, 450 miles of track are being projected as well as various other extensive improvements for the development of the island. The project of building a Cuban central railway is over 30 years old and the Cuban treasury has spent large sums of money in studying the line, plans and estimates. General Lacret claims that a foreign syndicate, such as the Cuba Company, has no right to encroach upon the state property, violating uncontrovertible rights. Sir William, when seen, stated that his company has no licenses or permits, but that he expected to build a railway from San Luis, near Santiago, to the centre of the province of Santa Clara. Electric systems in other towns and cities of the island are planned, as well as the long central, or main line, railway, which will probably be operated by steam.

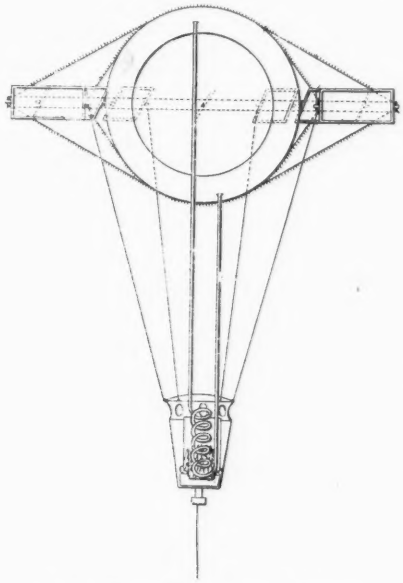
Electrical Patents

A new electric railway system has been patented by Mr. Benjamin W. Tucker, of Newark, N. J., the improvement consisting more particularly in the construction of a third rail. This rail is composed of a casing made of non-conducting and non-magnetizable material such as wood and having a longitudinal groove formed therein. A U-shaped trough of suitable insulating material is placed in the groove, which is covered by a sectional conductor, each section being insulated from the others by interposed blocks of insulating material. Within the groove of the rail is placed the feed wire composed of a good conducting and magnetizable metal, preferably iron. This wire is made continuous, and to permit of its necessary expansion and contraction it is coiled or looped at intervals, these coils or loops fitting in depressions arranged in the lining of the rail. The car is provided with a magnet that attracts the wire and draws it into engagement with the sectional conductor or covering, a suitable brush being provided, which is in contact with the casing, for conducting the current to the motor.



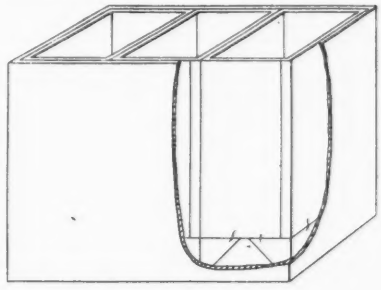
Electric Railway System.

Herr A. Palencsar, residing in Budapest, Austria-Hungary, has been granted a patent in this country on apparatus for collecting electricity from the atmosphere, which is a curiosity of invention. The idea underlying the invention is based on the modern theory of atmospheric electricity, according to which it is produced by the condensation of steam or aqueous vapors, and that the increase of potential is effected by the concentration of the small drops of water into larger ones, as the proportion of the surface of the drops to the volume of same is materially reduced thereby. According to this theory the water-droplets floating in the layers of air are considered as vehicles or carriers of the electricity, and a rational system of the deviation of the atmospheric electricity must derive it from the water-drops. This is attained by the present invention in the following manner: A collecting body in the form of a balloon is covered with a light wire netting that is studded with needles, and this netting is in electrical communication with a suitable collector. The machine is continually heated by a heating device, and owing to such heat, the water-drops immediately about the collecting body will be evaporated, so that their capacity is gradually reduced, while the potential of the charge grows until it reaches an indefinite height. It is readily apparent that the whole charge, as soon as the drops have been evaporated, will have passed to the collector, from which it can be conducted to the point of use. For the purpose of replacing the evaporated drops which have been deprived of their charge, the collector is raised and lowered by a connection made with the ground. At the same time, wings or blades located upon the balloon keep the same in a constant rotary motion. This up and down motion accomplishes the purpose of bringing the needles into contact with as many water particles as possible.



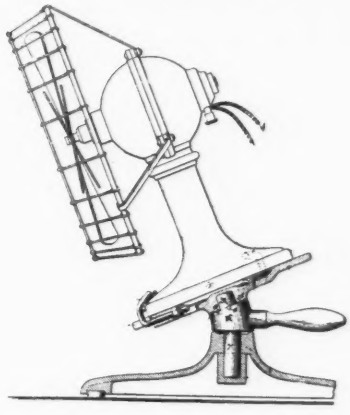
Electricity Collecting Balloon.

A great deal of attention is now being paid to electric appliances for motor vehicles. Among the patents recently issued is one on a battery cell, the object being to provide a construction which is not liable to break, and, therefore, especially applicable for use on electrically propelled carriages or in other situations where the cells are subjected to considerable vibration. According to the invention, the walls of the cell are constructed of wood, papier-maché, or other similar material, or compound, the sides being dovetailed together, or being formed by bending a piece of metal previously grooved or connected in any other convenient manner. This body is enveloped in a cover of canvas or other fabric which is attached with Jeffery's marine glue, india-rubber solution or other adhesive material having elastic, insulating and water-proofing properties. The inside of the cell is also coated with an insulating and water-proofing material. In practice, a number of these cells are fitted within a casing that is made of proper size and shape to receive them so that they will be tightly held together; this casing is constructed in a manner similar to the cells themselves. The inventor of this cell is Mr. Edward Tiquet, who resides at Romford, England.



A New Battery Cell.

A novel fan support consists of a base that can be placed upon a table or other flat surface and a plate to which the fan is clamped. The base and plate are connected in such a manner that the plate can be tilted to any desired angle or revolved, thus permitting of the tilting of the fan so that the current of air may be directed toward any point. The connection between the base and plate is in the form of a pair of pivotally connected pintles that are respectively seated in suitable sockets in the base and plate. A handle is so arranged and connected to these pintles that their angular relation may be changed as desired. The inventor of this device is Mr. Louis N. D. Williams, of Ashbourne, Pa., who has assigned a half interest in the patent obtained thereon to Robert W. Scott, of Philadelphia.



Support for Electric Fans.

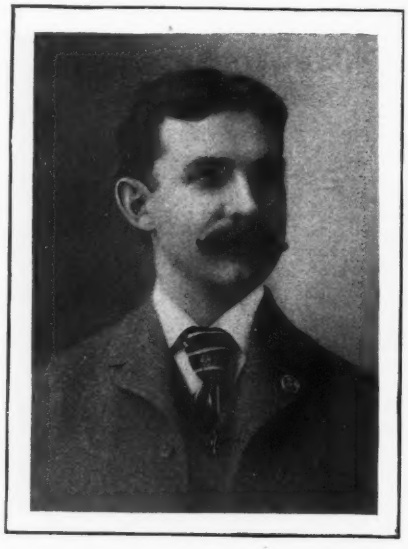
There are 150 miles of electric railways in Spain, of which Madrid has 16 miles.

The Value of an Electric Light Association.

At the closing session of the recent convention of the National Electric Light Association, President James B. Cahoon made some remarks as to the importance and value of the association and the duty of its members and of the electric lighting profession in general toward it. He said: "In my address to the association, I mentioned the fact that I had not unduly urged the members of the association to put their shoulders to the wheel and endeavor to increase our membership. When we compare our membership with that of the gas association, the waterworks association, and various other of the national bodies, we find that their membership is well in advance of ours. I do not know why it is that electrical men hold back from joining this association. One of the members remarked yesterday that perhaps it was due to the fact that in earlier years we had acquired a reputation for being somewhat boisterous at our conventions; but like many things in the earlier days that is a thing of the past. The association has come more and more each year to realize that these meetings are for the benefit of the members and that much can be learned by coming here and meeting other gentlemen in the same business and gaining knowledge from contact with each other.

"I hope during the year to come that you, gentlemen, will each and every one make up his mind to bring a new member into the association. We have made a good beginning. We want that work to go on and we want particularly to bring this association up to the plane on which it should be. There are 1,800 stations in the country that can afford to join this association. In our present membership we have, roughly speaking, 10 per cent of that number.

"The only way a central station manager can make progress and get out of the rut that the central station man is liable to get into is by going out in the world, moving around, and seeing what other people are doing. If he vegetates and remains at home, his plant droops gradually and he wonders why it is not paying dividends. He becomes plant-blind and does not know what other plants are doing. He does not know what his own plant is doing, and because so many central station managers have gotten into this position, the result is, as was reported last year, only a small percentage of the electric light plants are actually earning dividends. We were all much interested in the question of steam heating as an auxiliary to an electric light station, which was brought up here this morning. In the case of those plants that are to-day going behind I believe if they would take up that subject in one form or another, hot-water heating or steam heating, whichever their particular needs demand, they would derive a revenue which would put them on a paying basis. The same way with many of the plants that are now without storage batteries. If they would come here and learn of these things they would realize what is to be gained by the use of storage batteries; they would discover where their plants are weak and how they can overcome these weaknesses. During the past year I have had letters



MR. HENRY L. DOHERTY.
THE NEW PRESIDENT OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

from many small plants, saying they desired to make certain changes, but that they could not afford to pay an engineer and wanted to know if I would help them out. The president of the association stands ready at all times to help the small station, and wherever we can we give information which will benefit our smaller members. The big companies can take care of themselves. We have helped many companies in the question of municipal ownership. We have distributed various pamphlets and literature in this last year. I know, in fact, that this literature has done a good deal of good to central stations, and in numerous instances I have had replies thanking us for the assistance we have rendered; in one case the manager of the station said he hoped in time to persuade his board of directors to allow him to have the company join the association. Through our efforts we were enabled to knock out a proposed municipal plant in the city in question, and the old plant got the city lighting at remunerative prices; yet that plant to-day is not a member of our association. Many plants call on us for help and yet they do not contribute one cent to help the association. The only way we can get the data which we supply these companies is through the expenditure of money, and such companies should contribute to the support of the association.

"There is a field for missionary work in this association, and I rely upon you, gentlemen, to put your shoulder to the wheel and help your new president to carry this work forward and bring the association to the point where it belongs. We should have at the next convention a membership of 500, and we could have it if you, gentlemen, would take this little talk to yourselves to your hearts and, when you go home, not forget what has been said, but go to work and get a new member and bring him into the fold at once."

Mr. Henry L. Doherty.

Mr. Henry L. Doherty, who was elected at the recent convention of the National Electric Light Association as president of that body, was born in Indiana, May 15, 1870. He spent his youth in Columbus, Ohio, and at the early age of 12 years went to work for the gas company in that city. The superintendent of that company was Mr. Emerson MacMillin, and with this gentleman and the large interests with which he is connected, Mr. Doherty has been associated ever since. In 1896, on account of his health, Mr. Doherty removed to Madison, Wis., where he became general manager and subsequently president of the Madison Gas and Electric Company. Successful opposition to their own municipal competition at this place brought Mr. Doherty prominently forward and gave him recognition as one of the most earnest and ardent opponents of that economic fallacy. In connection with the large interests with which he was associated, Mr. Doherty was compelled to reorganize and often modernize electric light and power plants throughout the country, and he soon became recognized as an authority on the business management of central station properties. His paper before the last year's meeting of the National Electric Light Association on the subject of rates and charges will long be remembered as one of the best that has been presented in the history of that body. Mr. Doherty is now in Denver, Colo., being acting president of the Denver Gas and Electric Company. He is a member of many associations and, despite his youth, is well known throughout the United States as an active worker in the field of commercial electrical engineering.

NOTES ON LIGHT.

BY WILLIAM ROLLINS.

NOTE CXXVII — MELTING TERMINALS IN X-LIGHT TUBES.

When powerful surges are sent through X-light tubes of ordinary construction—that is, with small terminals—the aluminum is melted, the tubes being ruined. In earlier notes it was said that we depended on gas amalgamated with the terminals for producing an efficient cathode stream and X-light. On this theory the terminals are melted when the gas is becoming exhausted; the current finding insufficient means on which to ride the space of strained ether between the terminals, is degraded into heat in the metal. I also made another observation which should be considered now that more powerful generators are beginning to be used. It was said that in pumping a tube the gas was more rapidly removed from the anode than from the cathode. If this observation is correct then double focus tubes excited by alternating currents are not desirable for producing X-light, until we discover how to restore the gas in some simple way, for until that time it is necessary to conserve the supply and make each particle do its full duty as a producer of X-light when it is driven against the target. In a double focus tube each cathode is alternately an anode and therefore gets more quickly exhausted than the cathode of a single focus tube which is never an anode, if the theory that an ordinary induction coil or a static machine gives a unidirectional current is true.

NOTE CXXVIII—EXCITING X-LIGHT TUBES.

The object of this paper is to show why high-frequency currents are not at present suitable for exciting vacuum tubes for the production of X-light.

We depend upon gas amalgamated with the terminals of the vacuum tube to form an efficient cathode stream for producing X-light. The available supply of gas is limited. When it is exhausted the tube is not valuable, because there is no known practical means of restoring the gas.

Therefore, the best generator for exciting an X-light tube is one which uses the supply of gas most economically, producing most X-light from the least gas.

There are two types of generators in common use—those giving a unidirectional current (induction coils and static machines), and those giving an alternating current (Tesla or high-frequency coils).

There are several reasons why the latter are unsuitable. With the former the cathode is always supposed to be a cathode, but with the latter the cathode is half the time an anode. When the normal cathode is acting as an anode all the gas which is removed to convey the current is wasted, none of it producing available X-light. The gas is more rapidly removed from an anode than from a cathode. During the time, therefore, when a high-frequency apparatus is used to excite an X-light tube the gas is not only wasted but the rate of waste is high. With powerful high-frequency generators the terminals are rapidly robbed of their gas. The electricity, finding insufficient means of conveyance by convection over the space of strained ether between the terminals, heats the metal of the cathode, which, in consequence, is melted, the tube becoming useless.

MR. L. A. FERGUSON.
FIRST VICE-PRESIDENT OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

Double focus tubes are required for alternating currents. In these tubes the target, which is the metal surface on which the cathode streams strike and from which X-light arises, is not connected with either pole of the generator. It is an independent piece of platinum placed midway between two concave aluminum terminals, which are alternately positive and negative. Single focus tubes only are required for unidirectional currents. In these tubes the target may and should always be an anode. A target which is an anode is a more efficient source of X-light, because the particles of the cathode stream strike an anode at a higher velocity than they do a surface of metal placed in their path which is not an anode, the reason being that there are two causes for the velocity of the particles in the cathode stream—a repulsion from the cathode, because they have charges of like sign; an attraction to an anode, because its charge is of opposite sign. Velocity of impact is of prime importance in an X-light tube, because the higher it is the greater the temperature to which the particles are raised, and the larger the proportion of X-light to common light in the resulting radiation.

Double focus tubes are more expensive to construct. They are more subject to accidents than single focus tubes. It is more difficult to obtain good definition from a double focus tube, because there are two areas on the target from which X-light arises.

Before alternating currents can be made suitable for exciting X-light tubes some more convenient means of rectifying the current must be found and the surges must be under better control. As such generators require less wire for equal potentials they are cheaper to build and attempts should be made to adapt them.

The surges follow each other with great rapidity. As each surge removes gas from the terminals the available supply is more rapidly exhausted than with a unidirectional current, where the duration of each surge and the intervals between can be regulated. Until we learn to easily restore the gas to the metal, unidirectional currents are to be preferred. The potential should be high. Seven million volts would be superior to a less potential. The current surges should be of the least possible duration. We should aim to make them less than a millionth of a second. The size of each surge should be the least that will give a sufficient amount of X-light. The intervals should be the longest compatible with an apparently continuous light, or about a twelve-hundredth of a minute, for each is a period of rest to the tube during which the supply of gas in the metal is not diminished.

To operate a tube in this manner the greatest attention is to be paid to the designing of the device for breaking the current. I found that a rapidly revolving arm, which allowed the current to pass by dipping into an electrolyte once during each revolution, was a good method. In this way the duration of a surge was easily reduced to less than one-fourteenth of the period of rest. By placing two of these instruments in series, so that the second sent the current during only a part of the time that the arm of the first was immersed in the electrolyte, the duration of a surge was still further shortened.

Mr. L. A. Ferguson.

Mr. L. A. Ferguson, lately reelected first vice-president of the National Electric Light Association, has long been a prominent and influential member of that body. Although, like the new president, he is a young man, he has already earned, in connection with his work for the Chicago Edison Company, a wide reputation as an able and skillful electric lighting engineer.

Single-Phase Motors for Heavy Work.

Increasing demand for motor-driven pumping outfits has led the Wagner Electric Manufacturing Company, of St. Louis, Mo., to design a number of types of pumping outfits comprising single-phase alternating-current motors. Two of these applications are here illustrated.

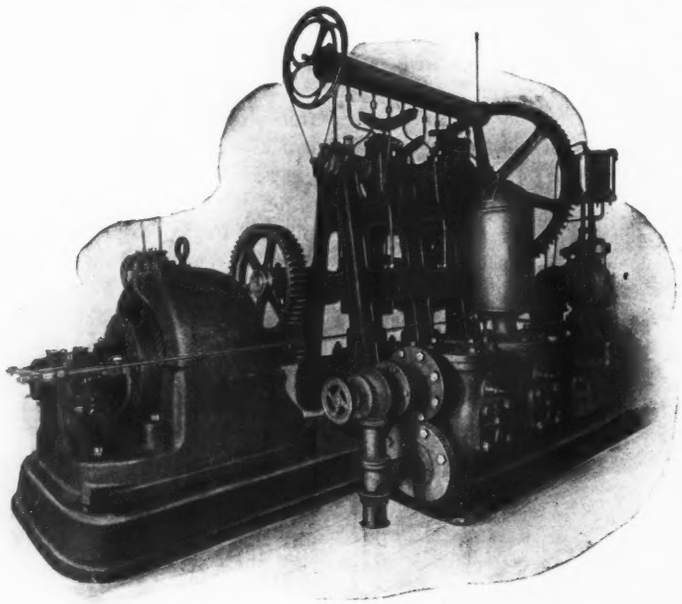


FIG. 1.—SINGLE-PHASE MOTOR PUMPING PLANT.

Fig. 1 shows a pump supplying 15,000 gallons per hour and used for the town waterworks of Whitehall, Ill. This motor is controlled entirely from the power-house situated about a mile from the pumping station and pumps its water through 6,000 feet of pipe line against a head of 166 feet into a reservoir at the top of a water tower. After the heavy part of the commercial lighting load goes off at night, it is started and operated until morning from the same generator which ordinarily carries the lighting.

A smaller pumping outfit is illustrated in Fig. 2, which represents a single-phase motor belted to a three-cylinder pump. Where considerations of space are important, the motor and pump may be brought closer together by the use of an idler, and the belt length shortened.

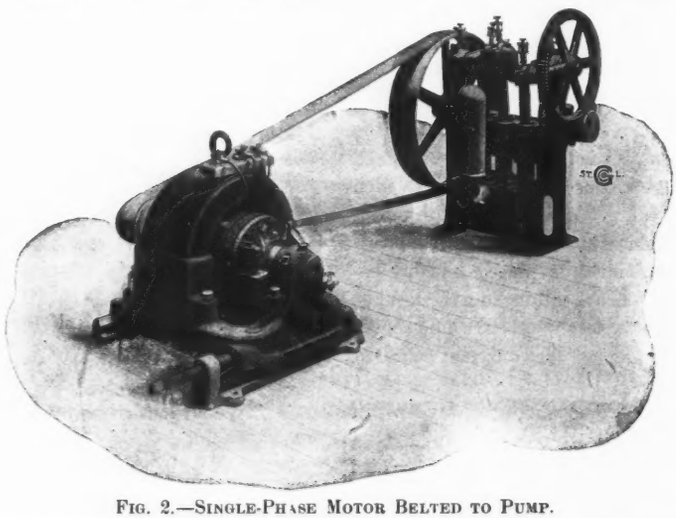


FIG. 2.—SINGLE-PHASE MOTOR BELTED TO PUMP.

German Models of Nernst Lamps.

The accompanying illustrations represent Nernst lamps now being manufactured by a prominent electrical construction company in Germany. It is stated that this commercial form of the lamp gives a horizontal light output of one Hefner unit for about 1.5 watts, or an efficiency of 1.7 watts per candle. The construction of the lamp may easily be understood by reference to the accompanying illustrations. The conducting oxide filament is heated by means of an enclosed platinum wire, which is switched out of circuit automatically when the oxides become conducting. The efficient life claimed is about 300

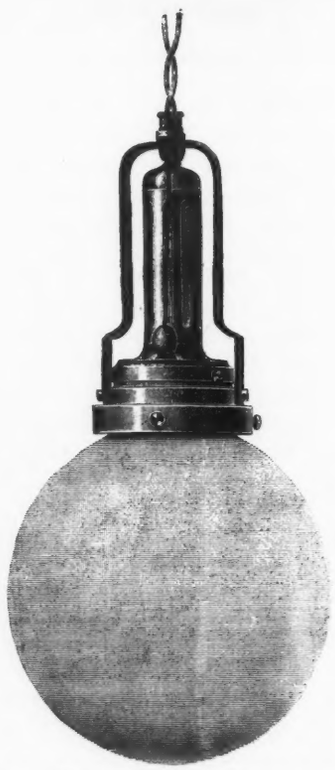


FIG. 1.—GERMAN FORM OF NERNST LAMP.

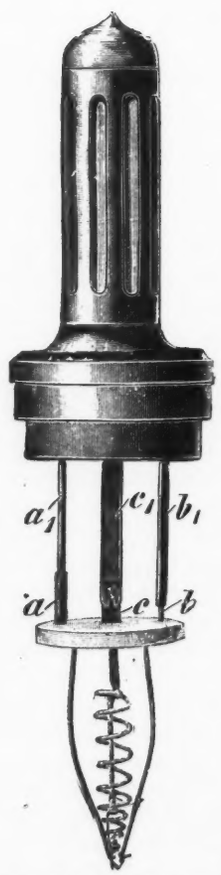


FIG. 2.—NERNST LAMP WITH GLOBE REMOVED.

hours. By loosening the screw, *s*, shown at the top of the glower, the whole may easily be slipped off and a new one put in place. The terminals, as the drawing of the lamp complete without the globe shows, are made of a tubular form and make good contact with one another as soon as the glower is put in place. The lamps are at present made for 110 and 220 volts alternating, and range in power from 65 to 135

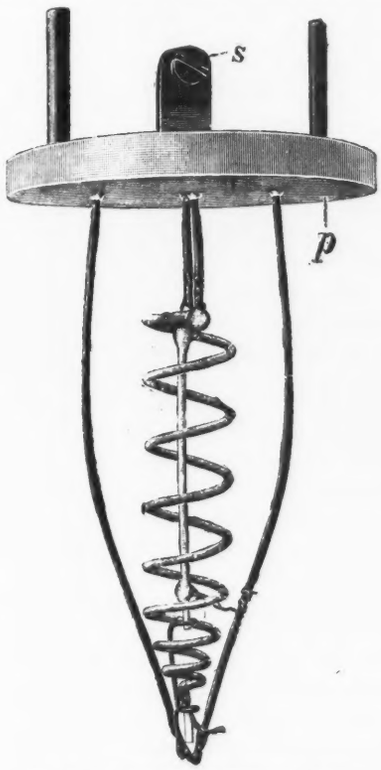


FIG. 3.—GLOWER FOR NERNST LAMP.

British candles. It is interesting to note that the present prices in Germany are such that the glower can be renewed at an expense of 50 cents.

Electric Rock Drills.

The accompanying illustrations are made from photographs of an electric rock drill mounted in horizontal and vertical positions. The apparatus is manufactured by the Gardner Electric Drill and Machinery Company, of Denver, Colo.

The drill is operated by an electric motor and accomplishes the same amount of work as an air-driven drill of the same weight with, however, the important difference that it absorbs a much smaller amount of power and is fed through less expensive connections. As the illustrations clearly show, the power of the motor is conveyed to the drill through a flexible shaft, this arrangement allowing the motor to be placed in any convenient position near the drill. In addition to the usual fuses, it has been found by the makers that it is well to include another safety device known as a slip-friction gear. This is done on account of the propensity of miners to replace a blown fuse with a nail or a piece of heavy wire in order to save themselves trouble.

In the usual equipment the motor i

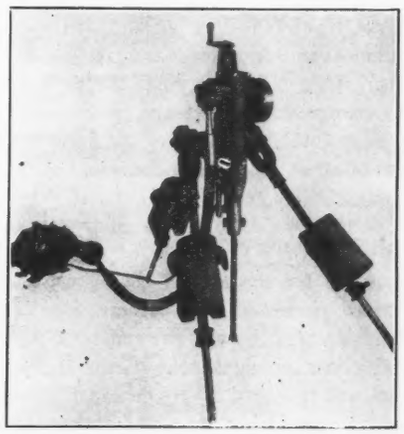


FIG. 1.—ELECTRIC ROCK DRILL.

permitted to run at 1,800 revolutions per minute, and is geared through a phosphor-bronze pinion and a cast-iron gear to a jack-shaft. The gear is loose on its shaft, which it drives by means of a friction clutch consisting of two fibre disks, one on either side of the gear hub. Pressure is maintained by a spring, which is set at sufficient tension to drive the drill under normal conditions. Should the drill point, however, stick in the rock and prevent rotation of the shaft, the cast-iron gear slips and thus prevents serious damage to any part of the mechanism. The power i transmitted from the flexible shaft to a pair of mitre gears, which rotate the crank-shaft and work a roller on the centre crank-pin. The crank-shaft transmits power to a draw-bar, in which is a slot working within a cam to give the piston of the drill a relatively quick motion forward and a slow return. Between the draw-bar and the piston of the drill are heavy spiral springs which are useful in forming a cushion and also permit the drill to be run without striking rock without damage. The balance-wheel, which forms part of the apparatus, is geared to a high speed, thus permitting the use of a light wheel and reducing the weight of the outfit. Rotation of the drill is effected by ratchet-wheels on the forward part of the body of the drill. In the piston are straight grooves engaging the corresponding ratchet-wheels and guiding the piston straight during the forward stroke, which administers the blow of the drill to the rock. Upon its return spiral grooves engage the corresponding ratchet-wheel and rotate the drill on its backward stroke. All motions of the drill are provided for by simple but solid clamps, a feature being a motion allowing the drill body to be moved to one side sufficiently to allow long steel bits to be removed and replaced without changing the setting of the whole apparatus. It is stated by the makers that these drills have been operating in mines in the western states for more than a year and are rapidly making their way in situations where compressed air and steam have hitherto been used.

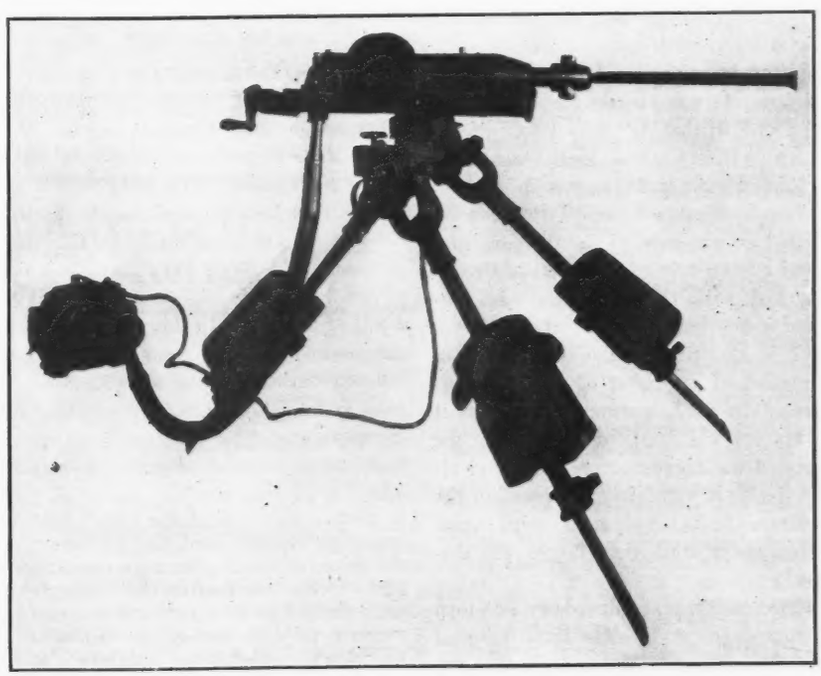


FIG. 2.—ELECTRIC ROCK DRILL ARRANGED FOR HORIZONTAL BORING.

The Last Traction Cable.

On the evening of Saturday, May 25, the Broadway cables of the Metropolitan Street Railway Company, New York city, were stopped. The work of removing them from the conduits was immediately begun, and by daybreak of Tuesday morning, May 28, the whole of the Broadway line, the most heavily traveled piece of street surface railway in the world, was in full operation on the electric conduit system.

Preparations for this change had been making for some time past. In the straight parts of the conduit the conductor rails had already been laid in place, as in those parts they did not interfere with the operation of the cable grips. On the curves, owing to the large number of sheaves and pulleys required by the cable, there was no room to install the conducting structure until these were removed. The fact that this line could be entirely changed over from cable to electric operation in two days reflects the highest credit upon the skillful and intelligent management which characterizes this system of street railways.

The history of the Broadway railroad is an epitome of street railway progress in the cities of this country. Fourteen years ago Broadway was traversed by a line of stages, and those rumbling and inadequate vehicles were considered the only possible means of transit on that crowded thoroughfare. It was plainly foreseen by the wise people of that day that it was utterly impossible to run cars on tracks in a street so crowded with traffic as was Broadway!

After a memorable and bitter contest a franchise was secured for the construction of a horse-operated railroad in Broadway, and with this franchise was connected a municipal scandal of grave proportions, resulting in the trial and condemnation of a number of municipal officers. The road, however, as soon as it was started was recognized to be a public utility of the highest importance, and almost before it was fairly in operation the question of its equipment with some motive power other than horses was discussed.

Within a few years Broadway was torn up from end to end for the installation of a cable system, probably the finest that was ever put down, and this has continued to operate up to last week. Visiting strangers at that time were taken to see the Broadway cable road as one of the sights of the city. It was regarded as the most superb example of street railway equipment extant.

A few years ago the company commenced experimenting upon a branch of its lines in the upper portion of Manhattan with the conduit system of electric traction. The success of this having been assured, a number of the main lines running north and south along the avenues of the city were equipped; but Broadway, with its tremendous traffic and crowded tracks, was left for the last so that the experience and knowledge gained on the other roads might be made useful when the change was made there.

New York now possesses the finest system of street traction in the world. The administrative genius of Mr. H. H. Vreeland, the president of the Metropolitan Street Railway Company, is largely responsible for the altered conditions and for the perfection of this service. The operation of such a railway system in such a city is a public benefit of the highest class, and it is hard to give too much praise to the men who have undertaken the difficult and complicated engineering, mechanical and financial problems involved in its development.

An Electrically Operated Mine in Idaho.

One of the most interesting electric power plants in the West is stated to be the one which is now operating the mines and mills of a large silver company at the Swan Falls, on the banks of the Snake River, near Boise City. Snake River flows through southern Idaho and along the western border of the state for nearly 300 miles and after it plunges over the Shoshone Falls there is one place only where it can be dammed. The main part of the stream runs between such high cliffs that the water can not be diverted for irrigation purposes. At Swan Falls there is a reef of rock lying across the stream and making a fall of five feet. In this place a dam for the power plant was constructed and four 72-inch turbines installed. Each wheel runs under a 17-foot head, generating 750 horse-power. Pits for two more wheels have been constructed and 16 may be added by digging new pits, for which there is room. The cost of the plant, with its entire equipment, and the appliances at the mines and mills, has been about $350,000. Power was costing the mining company about $50,000 a year and this expense was annually increasing, so that when it was found possible to generate electric power the present plan was determined upon.

A New Power-House in Michigan.

Press reports state that the Michigan Central Railroad Company is to build a $300,000 power-house, electric lighting plant and machine shop at Jackson Junction, Mich.

The Independent Telephone Convention.

On Tuesday, June 11, the Independent Telephone Association of the United States of America will meet at Buffalo, N. Y. The programme of the meeting was printed in full in the ELECTRICAL REVIEW for May 25. Mr. S. E. Wayland, the second assistant secretary, writes from Scranton, Pa., under recent date, that from the number of applications he has received for hotel accommodations the coming convention will be the most largely attended in the history of the association.

The address of welcome to the convention will be made by the Hon. Conrad Diehl, Mayor of the city of Buffalo, in the banquet room of the City Convention Hall, at the corner of Elmwood avenue and Virginia street, and in this place the sessions of the convention will also be held. In addition to the three sessions, on Tuesday, Wednesday and Thursday, there will be inspections of exhibits made by manufacturers at the Iroquois Hotel, a visit to the Pan-American Exposition and Niagara Falls, and the transaction of the usual business of the convention. The papers upon the programme are of an exceedingly important character. It is believed that the meeting will be not only the best in the history of the association, but will be regarded as an epoch-making event, in that the conditions of the telephone industry to-day are such that it may be expected that rapid development will take place in the independent telephone field, and that the association, combining as it does the strength and ability of many companies, will lead the way to a wide extension of independent telephone interests.

A New Railway Franchise Asked for in Detroit.

Messrs. Henry A. Everett and E. W. Moore, of the Everett-Moore Syndicate, are attempting to obtain a franchise for a consolidation of the suburban roads running out of Detroit, Mich., and ask the city council for a new blanket franchise, offering seven fares for 25 cents, with universal transfers until the present franchise terms expire, and after that—about 10 years from now—eight tickets for 25 cents, five-cent single fares and universal transfers. The gentlemen interested believe that their proposition will be accepted, and think it will meet with little opposition except from those who desire municipal ownership, stating that they will be satisfied if they can get the property on a permanent basis where it will take care of its bonds and pay the dividends on its stock, believing that money can be made on the rates of fare named.

Current Electrical News

Commercial News

EXPORT AND DOMESTIC

It is reported that the Paris electric cabs which were withdrawn last fall cost a loss to the company of $900,000. The cost of maintenance proved higher than calculated and a much smaller patronage was secured than was expected.

New York and Philadelphia capitalists are said to have taken hold of a Baltimore scheme to utilize the water power of the lower Susquehanna to the extent of 100,000 horse-power, to supply electric power to Philadelphia and Baltimore, and to install a system of electric railways with numerous feeders, between New York and Washington.

The Imperial Water and Power Company has placed an order for what will be the largest electrical single pumping engine in Canada. The total weight of the engine is something over 200 tons, and the machine will measure 40 feet in length by 20 in width. One of the gear wheels will be 30 feet in diameter. In capacity the engine will be able to throw a column of water 400 feet high and pump 5,000,000 gallons every 24 hours. The contract price is $27,000, and the manufacturer the Northey Manufacturing Company, of Toronto, Quebec.

American automobiles are reported to have a future in Russia, as the buyers there are said to feel the need of our vehicles and are asking for information relative to steam and electrically propelled carriages and wagons of all sorts. While some manufacturers of electric vehicles are of the opinion that trading with Russia can not be carried on successfully so long as the present high tariffs exist, many others think that there should be no difficulty in establishing substantial trade relations with the importers in Moscow, St. Petersburg and other large Russian centres of capital and industry.

It is reported that a satisfactory test of the Pupin system between Chicago and New York has been made by the American Telephone and Telegraph Company. Copper wire weighing 344 pounds to the running mile gives as good results as wire formerly weighing 870 pounds to the mile, which at 18 cents per pound would reduce the cost of telephone construction for wire alone $94.68 per mile. It is expected that a circuit for commercial use will soon be established between New York and New Orleans, making conversation practical between the Gulf and Texas points through to the New England states.

The consolidation of a number of incandescent lamp manufacturers is said to be about completed. Mr. F. S. Terry, of the Sunbeam Lamp Company, and Mr. J. B. Crouse, of the Fostoria Lamp Company, are the prime movers in the consolidation. The companies that will be included it is expected will be the Buckeye Electric Company, Fostoria Lamp Company, Sunbeam Lamp Company and the Bryan-Marsh Company. The purchase of the companies will be made outright and they will be consolidated under one management and operating expenses greatly reduced. Some of the factories will be closed and the facilities of others increased.

Consul Morgan writes from Aarau, Switzerland, April 10, 1901: "Nearly every mail which comes to this office brings letters from American manufacturers and exporters asking for names and addresses of firms doing business in Switzerland, presumably for the purpose of sending out circulars, etc. While this office is always willing to comply with the request, it often happens that the firms doing business in the particular line requested are so numerous that it is only possible to give a relatively small number of names. I would suggest that those desiring the information as above set forth should purchase the 'Registre du Commerce,' which is published annually and contains the name and address of every business house in Switzerland, and is so arranged in one part of the volume that the different lines of business are grouped under separate headings for ready reference. The cost of the 'Registre' is $2, and it can be obtained from any bookseller in Switzerland."

Financial plans for the complete consolidation of the street railway interests of Pittsburgh, Pa., and vicinity have been completed, the plan providing that the securities of the Philadelphia Company and the Consolidated Traction Company, of Pittsburgh, shall be acquired by a new company to be formed, which will issue five per cent collateral trust bonds, five per cent cumulative preferred stock, and five per cent common stock. The Philadelphia Company, besides its extensive artificial and natural gas properties and electric light plants, owns the Union Traction Company, of Pittsburgh, which has $14,752,000 of common stock and about $4,000,000 of five per cent preferred stock, with $6,500,000 of bonds. The Consolidated Traction Company, which is also to be merged with the Philadelphia Company, is one of the Widener-Elkins properties, having $15,000,000 of common stock and $12,000,000 of six per cent cumulative preferred. The merger will practically consolidate all the street railway interests of Pittsburgh and Allegheny, and the negotiations were conducted through Messrs. Alexander Brown & Sons, of Baltimore, Md., Brown Brothers & Company, of New York, and the Maryland Trust Company.

Electric Lighting

A municipal electric lighting plant is to be installed by the town of Livermore, Cal.

Manton, Mich., will have an electric lighting plant of 1,500 incandescent lamp capacity in operation by July 1.

A ten-year franchise for an electric lighting plant at Tekamah, Neb., has been granted to Mr. J. Glasson. Construction work has been begun.

A franchise has been granted by the village of Eastwood, N. Y., to the electric light company for the illumination of James street and Burnet avenue.

Middleport, N. Y., is to be electrically lighted, and a company has been formed to push the matter, and a plant will soon be erected at a cost of $32,000.

Mr. John M. Westcott has made arrangements by which he will loan the Richmond, Ind., city council $100,000 for the erection of an electric lighting plant.

A complete electric lighting plant was recently shipped by its manufacturer in Crawfordsville, Ind., to Plymouth, Wis., the sale price being $16,000. The same manufacturer is at work on similar plants for Sturgeon Bay, Ripon and Port Washington, all in Wisconsin.

The local electric lighting company in Freeport, L. I., has recently ordered four 50-light and two 30-light General Electric transformers to supplement its service.

Mr. George H. Burkhart has been given a franchise for electrically lighting the town of Trenton, Mich. Twenty street lights will be furnished at $90 a year for five years.

Ground has been broken and construction work begun on the large new plant of the Rockingham County Light and Power Company, of Portsmouth, N. H., at its newly acquired property on Daniel street.

It is probable that bids for a 20,000-horse-power electric lighting plant will be asked for in Reading, Pa., by the People's Light and Power Company, which expects to have one of the best-equipped plants of its kind in the country.

The electric plant of the West Kootenay Power and Light Company at Bonnington Falls, in the gold fields, is to be greatly extended, a contract having been let for machinery which will enlarge the plant to 12,000 horse-power.

The entire electric lighting and power system of the Galesburg, Ill., Gas and Electric Light Company is being refurnished, and improvements and extensions are being made. Several months will be consumed completing the work.

Plans have been authorized by the county commissioners of Cleveland, Ohio, for an electric plant to be installed in the courthouse at an expenditure of $9,960. The plant will be in operation as soon as it is possible to get it ready.

By a unanimous vote of the directors of the Kansas City, Mo., Gas and Electric Light Company, that company was disorganized recently in New York city. It was organized in 1892 to compete for the lighting business of Kansas City, but as it never applied for a franchise the project has been dormant for many years.

Consular reports from Amsterdam, Holland, state that H. R. der Mosch and H. J. Joostenz, of Batavia, Java, have been granted a 30-year franchise for the operation of electric light and power plants in the cities of Padang and Djokjakarla. The former city is the largest on the west coast of Sumatra, having a population of 35,000, while the latter numbers 85,000 inhabitants and is reached by rail from Samarang.

The proposition of the Fonda, Johnstown & Gloversville Railroad Company to furnish electric light for Amsterdam, N. Y., has been accepted by the officials of that city, and a plant which will cost $250,000 will be erected by the railroad company. The plant will furnish power for lighting and also for the use of the trolley lines immediately controlled by the railway company in Amsterdam and in Montgomery and Fulton counties.

A number of men, authorized in their act by the village board of Ilion, N. Y., recently destroyed the old electric lighting plant in that village and cut down the poles of the County Power Company, which owned the plant, and destroyed its system. The contract with the company to supply the village with electric lights expired last fall, and a municipal plant was recently installed. Some time ago the company was ordered to remove its wires and poles from the street, but as no attention was paid to the order the local authorities ordered the plant destroyed.

Electric Railways

The Indianapolis, Lebanon & Frankfort Electric Railway Company has begun construction work on its lines.

A large power-house is soon to be built in Junction, Mich., for the Detroit & Chicago Traction Company at a cost of $250,000.

Construction work has been actively begun on the Truesdel-Kenosha, Wis., electric railway line, which will be built as far as Truesdel during the present year.

Capitalists of Belvidere, Ill., are backing the proposed electric railway from that city to Marengo and Woodstock, the project being to connect all of the resorts with the larger Illinois and Wisconsin towns.

Plans for improved car shops have been submitted to the Rochester, N. Y., Railway. The shops are to measure 173 by 200 feet, and the estimated cost of removing the present building and erecting the new one is about $200,000.

The lines of the Metropolitan Rapid Transit Street Railway Company, of Birmingham, Ala., are being constructed. The officers of the company are: President, J. B. Burriss; vice-president and treasurer, E. F. Enslen; secretary, H. M. Horton.

A franchise has been granted after considerable opposition by the authorities at Tipton, Ind., to the Union Traction Company for an extension of its lines from Elwood to Tipton. Surveys of the line are already well under way.

A new belt line electric railroad, to be run in opposition to the Chicago Junction and the Chicago Terminal Transfer Railroad companies, has been incorporated under the name of the Illinois Northern Railway Company, with a capital stock of $500,000.

A franchise has been granted by the city of Kaukauna, Wis., to the Wisconsin Traction, Light, Heat and Power Company, to extend its lines into that city. Preliminary surveys for the building of the line have been completed and construction work will soon begin.

Franchises for an electric road to run from Adrian to Ann Arbor, Mich., are said to have been secured to within 12 miles of Ann Arbor, and the promoter back of the line, Mr. William B. Hatch, of Detroit, states that the Everett syndicate will build the line this year.

The Wilkesbarre & Hazleton, Pa., Railroad Company, which has recently been formed by officers of the Lehigh Traction Company, will build a 25-mile line between Wilkesbarre and Hazleton to connect Scranton and Hazleton and cover the entire Wyoming Valley coal fields.

Rapid progress is being made on the extensions to the street railway system in Everett, Wash., which was recently secured by the Everett Improvement Company from the Rockefeller interests. The company has recently spent about $200,000 in machinery and appurtenances.

It is reported that the Cleveland syndicate which recently purchased the street railway properties of Utica, N. Y., has bought the Herkimer, Mohawk, Ilion & Frankfort, N. Y., street railroad. Extensions are to be made and the new line just purchased will be finely equipped.

An electric street railway line which will make a complete circuit of the factory districts of the city has been begun in Kenosha, Wis. Chicago capitalists, headed by Mr. B. J. Arnold, are back of the line, which will be about seven miles in length and completed about September 1.

The project for connecting the Kansas towns of Coffeyville, Independence and Cherryvale by an electric line is rapidly assuming completion and the road will be built and equipped at a total cost of about $300,000. The road will be about 30 miles long. Its promoters are T. H. Stanford, G. T. Guersey and I. B. Wallace.

Sunday, May 26, a collision between two high-speed electric cars on the Albany & Hudson Railroad, near Hudson, N. Y., resulted in the death of the two motormen and three passengers and the injury of a number of others. One of the motormen was at fault in disobeying a signal and failing to stop at a passing point.

Construction work has been begun on the new Bergen turnpike trolley road which will run from Hoboken to Paterson. President Young, of the Jersey City, Hoboken & Paterson Street Railway Company, lifted the first spadeful of earth. The road will cost about $1,000,000 to build and will be equipped with modern trolley cars.

The village of Hempstead, L. I., has given a franchise to the Mineola, Hempstead & Freeport Traction Company to build a trolley road through that village to connect with the proposed line to Queens. Another license has been granted by Hempstead to the Long Island Traction Company which will run a motor stage line through the village.

The committee of the House of Lords (London, England) which has been considering the Behr "monorail" system of high-speed electric railways, authorized on May 17 the construction of a line between Liverpool and Manchester, England. The distance is about 30 miles, and a maximum speed of 100 miles per hour is to be attained.

A new electric line to run from Joliet to Ottawa, Ill., has been given franchises and rights of way up to the Ottawa City line. The route lies through rich farming country and it is believed that the road, as facilitating the quick haulage of corn and oats and the bringing of possible customers to the farmers' cribs, will prove of great advantage.

Reports from Chicago, Ill., state that the Northwestern Elevated, the Lake Street Elevated, and the Union Loop Railway companies are to be consolidated with the Metropolitan Elevated Railroad. Arrangements for the consolidation are practically completed and it merely remains to settle the final details of the merger, which will be attended to in a few days.

In the city of Montreal, Canada, there are 102½ miles of electric railway operated by six 600-horse-power engines and one 300-horse-power engine, which in turn run twelve 200-kilowatt generators, six 300-kilowatt generators and one 1,500-kilowatt generator. Last year, 43,362,262 passengers were carried and the business for the year showed a net profit of $647,246.64. The figures given do not include suburban roads.

The Niagara, St. Catherines & Toronto Railway Company, of Ontario, Quebec, has purchased the Port Dalhousie, St. Catherines & Thorold Electric Railway, Limited, for $90,000. The latter road is seven miles long and is fully equipped. It is stated to be the oldest electric railroad in Canada and connects the city of St. Catherines with the towns of Merritton and Thorold. It will be used as an extension of the purchasing road.

Rights of way have been secured for the new electric line between Cleveland, Ohio, and Detroit, Mich., and it is expected that before Christmas the electric cars will be in operation between the two cities. Forty miles of the track will be laid this summer to complete the Lake Shore line between Loraine and Toledo. The entire line will be about 135 miles long and its equipment modern in every respect. The entire system will represent a total investment of about $3,000,000.

The long-talked of trans-Ohio electric railway is to be built, and a syndicate has projected a road to run from Cleveland, Ohio, to Wheeling, W. Va. The company which will build the line has been formed and Mr. Henry Everett, of the Everett-Moore syndicate, declares a consolidation of the lines centring in Cleveland to be a certainty. The lines will run through and past many attractive pleasure resorts. Upwards of half a million people are tributary to the lines as projected.

Statistics compiled by the Royal Bureau of Electric Railways, in Saxony, concerning the traffic of Saxonian electric roads during 1900, give a very comprehensive survey of the situation, and according to the reports the traffic has increased very considerably over that of the former year, as a consequence of the opening of many new lines in the larger cities. The report states one curious fact, namely, that "many women in this country not only insist upon riding upon the front and rear platforms but on getting on and off cars while still in motion."

Electric street car lines are multiplying in the vicinity of Los Angeles, Cal., and there are now roads running out of that city to Pasadena and Santa Monica. It is now proposed to run a line through the San Gabriel Valley to Monrovia and another line to Santa Ana by way of Whittier, the former road being about 20 and the latter about 30 miles long. A third line will be an extension of the Santa Monica road along the coast through Ballona, Redondo, San Pedro and Long Beach and thence back to Los Angeles by direct course. The suburban roads now in existence are said to have proved very profitable, and the money earned during the past year has been set aside for improvements.

A reorganization of the Pittsburgh, Pa., & Birmingham Traction Company has been effected and the Mellon Brothers, bankers, and their associates have assumed entire control. The new officers are: President, W. L. Mellon; secretary and general manager, G. S. Davidson; assistant secretary, W. H. Rogers; treasurer, R. B. Mellon. The Birmingham property, which was recently purchased by the Mellon interests, is among the most valuable street railway systems in the country, consisting of the Pittsburgh & Birmingham Traction Company and 29 tributary lines, two valuable terminals, 33 miles of tracks and two inclined planes on the south side (Pittsburgh), are included. The new line which is now being constructed from Monongahela to Pittsburgh will enter the latter city over the Birmingham tracks.

Two electric street railways are proposed for communication between the cities of Kansas City and St. Joseph, Mo. One of the lines, the Kansas City & St. Joseph, is known as the Overland route, being promoted by local parties, while the other, the Kansas City, Parkville & St. Joseph, is backed by Messrs. Denison, Prior & Company, bankers, of Cleveland and Boston, and is known as the River route. The first line is the more direct and a trifle shorter than the other, but from an engineering standpoint is more difficult to construct and may be more expensive to operate. The second line will serve the people in Atchison, and passes by the Beverley coal mines, closely following the Missouri River. The Kansas City *Journal*, which presents in a recent issue a map sketching the routes of the two lines, states that the field seems a good one but the present conditions do not warrant the construction of more than one line and it does not seem certain which of the two will really be built.

Personal Mention

MR. S. M. BUTLER, of New York city, has been appointed secretary of the Automobile Club of America, *vice* Mr. Tousey, deceased.

MR. D. M. BOYD has resigned as superintendent and purchasing agent of the New Paltz, N. Y., & Walkill Traction Company, having accepted the superintendency of a steam road in New Brunswick, Canada.

MR. W. E. MANDELICK, lately connected with the Sprague Electric Company and the Johnson-Lundell Company, sailed recently for London where he will be associated with Mr. Charles T. Yerkes's underground railways.

MR. JOHN C. NEELY, representing the Kellogg Switchboard and Supply Company, of Chicago, was a New York visitor this week. Since graduating from Princeton Mr. Neely has entered actively into the telephone engineering field.

PROFESSOR ELIHU THOMSON was awarded the Rumford medal by unanimous vote of the American Academy of Arts and Sciences at its last meeting, the award being made for Professor Thomson's inventions in electric welding and lighting.

PROFESSOR THEODORE W. RICHARDS, of Harvard University, has been granted the sum of $500 from the income of the Rumford fund of the American Academy of Arts and Sciences to aid him in his research upon the Thomson-Joule effect.

MR. CLINTON L. ROSSITER, late president of the Brooklyn, N. Y., Rapid Transit Company, recently announced that he had decided to accept the presidency of the new million-dollar trust company, which will have offices in Temple Bar Court, in Brooklyn.

MR. H. DE STEESE, who has been for some time past representing American engineering firms in London and on the Continent of Europe, has joined the Morris Electric Company, New York, as traveling representative. Mr. De Steese will have the territory east of New York.

MR. BENJAMIN J. WEEKS has been recently appointed general superintendent of the Tacoma, Wash., Railway and Power Company, *vice* Mr. F. L. Dame, resigned. Mr. Weeks was for 10 years prior to his present engagement superintendent of the Quincy & Boston, Mass., Street Railway Company.

MR. W. S. DIMMOCK, general manager of the Omaha & Council Bluffs Railway and Bridge Company, and the Omaha, Council Bluffs & Suburban Railway Company, of Nebraska, has accepted the general managership of the Richmond Railway and Power Company, which owns some 80 miles of lines in Richmond and Manchester, Va.

MR. CHARLES H. FINLEY has succeeded Mr. George Dunning as assistant chief operator of the Western Union Telegraph Company, at Chicago, Ill. Mr. Finley has a record as an operator, having handled 500 ordinary messages in nine hours between Chicago and St. Paul at a time when the pen was considered better than the typewriter.

MR. GEORGE W. BAUMHOFF, late general manager of the St. Louis, Mo., Transit Company, has become interested in the new Las Vegas, N. M., & Hot Springs Electric Railway, Lighting and Power Company, which will build an electric railway to connect Las Vegas with neighboring towns and construct electric lighting plants to illuminate Las Vegas and towns in the vicinity.

DR. CLAYTON H. SHARP, instructor in physics at Cornell University, has resigned this position to become testing officer of the Lamp Testing Bureau. This bureau is a corporation organized under the laws of the state of New York, which has hitherto been engaged solely in testing incandescent lamps, but which is in the near future to establish a laboratory in New York city for testing and standardizing not only electric lamps, but also all kinds of electrical apparatus and instruments.

LIEUTENANT-COLONEL E. S. DUDLEY AND COLONEL DUNWOODY, United States Army, were recently highly complimented by General Leonard Wood, military governor of Cuba, for the services they have rendered in connection with the telegraph service and law department of the island. General Wood stated in his report that at the time of the invention telegraphic conditions in Cuba were chaotic, while now there is a system from one end of the island to the other equal to that in the United States.

MR. E. J. HALL, vice-president and general manager of the American Telephone & Telegraph Company, and Mr. W. D. Sargent, vice-president and general manager of the New York & New Jersey Telephone Company, sailed on Saturday of last week for a six weeks' visit to Europe. Mr. Hall and Mr. Sargent stand at the head of their profession of practical telephony, and their numerous friends in the electrical field all extend to them best wishes for a pleasant and profitable voyage and rest.

MR. GEORGE F. PORTER, manager for Mr. W. R. Brixey, of the Kerite insulated wires and cables, went direct from the Niagara Falls convention of the National Electric Light Association, of which he is the indefatigable secretary, to Alaska. It is Mr. Porter's intention to lay the Brixey Kerite cables for which the government recently contracted. The cable is 125 miles in length, submarine, and is to connect Juneau and Skagway, Alaska. This is the second large order the government has given Kerite cables for the severe Alaskan work.

Obituary Notices

MR. JOB H. JACKSON, president of the Jackson & Sharp Company, car builders, of Wilmington, Del., died in that city on May 23. Mr. Jackson was born in Chester County, Pa., and is survived by a widow and nine children.

MR. A. LANGSTAFF JOHNSON, consulting and electrical engineer of Richmond, Va., died recently at his residence in that city. Mr. Johnson was 50 years of age and is survived by a widow and four children. He was born in Richmond, and graduated from the Virginia Military Institute, after which he was employed in the construction of the Chesapeake & Ohio Railway and assigned to important tunnel work in which he acquitted himself with credit. In 1876 he was made city engineer of Manchester, Va. In 1888 and 1889 he built part of the railway system of the Richmond Railway and Electric Company. His next important work was track building for the New Orleans & Carrollton Railway Company. Later on he was the chief engineer of the Hestonville, Mantua & Fairmount Railway Company, of Philadelphia. He also acted as chief engineer for railway companies in Meadville, Pa., and elsewhere. In 1896 the Franklin Institute, of Philadelphia, awarded him the John Scott medal for a complete system of electric railway bonding. Mr. Johnson was a member of the American Institute of Electrical Engineers, the American Society of Civil Engineers and the Franklin Institute.

Legal Notes

PEDESTRIANS' RIGHTS—An appeal of the Union Railway Company, of New York city, against a jury's verdict of $4,000 for the death of David E. Legare, was denied in an opinion recently handed down by the Appellate Division of the Supreme Court. The boy Legare was run down while crossing the car tracks in 1896, and the evidence showed that the car was traveling at a high rate of speed, and that it was 75 feet distant when the boy attempted to cross the roadway. The opinion in which all the justices concur states that there is no question, if the motorman had been attending to his business, but that he would have seen the boys, and that it certainly was not negligence for the latter to attempt to cross the track when the car was 75 feet away, but that it was gross and criminal negligence for the motorman when, within 15 feet of the boys, to put on additional power and run them down. Whether or not a person crossing a street in the city of New York occupied by cars propelled by electricity or cable, and often running at high rates of speed, is guilty of contributory negligence where there is evidence which would justify a finding that the defendant was negligent, which must usually be for the jury; for in a case where a car can be controlled so as to avoid running down a person crossing a track, it can not be said that it was negligence as a matter of law for a person to attempt to cross the track. The right of the railroad company to use the public streets is conditional upon the right of the public also to use them in the ordinary way, and no railway company has the right so to block the streets that the public is excluded from crossing them except at the risk of being run over. It can not, therefore, be contributory negligence for a person to attempt to cross a track when the car is at such distances that the motorman can prevent its running down a person crossing the track if he be attending to his business and operating the car in a prudent and careful manner.

Literary

The Librairie Dunod, in Paris, will soon publish an important work on electric automobiles by MM. Gaston Sencier et Delasalle. It is believed that this new work will be the first really complete treatise on the subject.

The Popular Science Monthly for June, among other articles of unusual interest, contains a notable contribution by Professor Robert H. Thurston, director of Sibley College, Cornell University, wherein he traces the progress and tendency of mechanical engineering during the nineteenth century. There is also an address by the late Professor Henry A. Rowland, of Johns Hopkins University, entitled "A Plea for Pure Science," in which the author points out the defects and needs of science in America.

THE MAY number of the *Inventive Age and Patent Index*, of Washington, D. C., is particularly interesting. In addition to the usual indexes of patents recently issued, and illustrations of clever new patents, it contains portraits of the newly appointed Commissioner and Assistant Commissioner of Patents, and the latest rulings in patent matters, besides scientific matter of general interest. It is now celebrating its thirteenth anniversary. It shows every evidence that the *Age* is improving with age. A sample copy is sent free.

New Incorporations

NILES, OHIO—New Electric Company. $25,000.

AKRON, OHIO—Garl Electric Company. $25,000.

MONROE, MICH.—Monroe Traction Company. $10,000.

ANITA, IOWA—Rural Telephone Company. $10,000.

ST. JOSEPH, MICH.—Michigan Electric Railway Company. $25,000.

DETROIT, MICH.—Detroit & Toledo Short Line Company. $1,000,000.

WILMINGTON, DEL.—Electric Motor and Generator Ventilating Company. $100,000.

CANTON, OHIO—People's Light and Heat Company. $100,000. Incorporators not named.

TRENTON, N. J.—Twin City Transportation Company. $100,000. Incorporator: B. S. Dunn.

ORLANDO, FLA.—Orlando Water and Light Company. $100,000. Incorporators not named.

CHICAGO, ILL.—The Harvard Electric Company has increased its capital stock from $2,500 to $10,000.

STRONG STATION, IONA COUNTY, MICH.—Eastern Independent Telephone Company. $1,000.

PHILADELPHIA, PA.—American Electric Manufacturing Company. $300,000. Incorporators not named.

TRENTON, N. J.—Southern Central Telephone Company. $100,000. Incorporators: J. W. Avery and others.

BELVIDERE, ILL.—The Belvidere Telephone Company has increased its capital stock from $25,000 to $50,000.

TRENTON, N. J.—Wheeler Electric and Manufacturing Company. $100,000. Incorporator: William M. Pawley.

PATAPSCO, MD.—Patapsco Electric and Manufacturing Company. Incorporators: V. G. Bloede and Robert Diggs.

ST. LOUIS, MO.—The Fire-Alarm Company of Missouri has increased its capital stock from $20,000 to $40,000.

EMPORIA, IND.—Emporia & Anderson Telephone Company. $1,000. Directors: D. Rector, V. P. Gale and others.

SHARPSBURG, CT.—Sharpsburg Home Telephone Company. $3,500. Incorporators: B. T. Wright and R. A. Atkins.

LOS ANGELES, CAL.—The San Gabriel Electric Company has increased its capital stock from $500,000 to $1,000,000.

TRENTON, N. J.—National Electric Protection Company. $100,000. Incorporators: H. A. Buxton and L. A. Johnson.

TYLER, TEX.—Tyler Telephone Company. $40,000. Incorporators: S. F. Richardson, J. W. Wright, J. K. Duffy and others.

PHILADELPHIA, PA.—American Light Company. $5,000,000. Incorporators: J. E. Bryan, M. C. Reed and A. D. Phillips.

YATES CITY, ILL.—Ideal Telephone Exchange. $2,000. Incorporators: W. G. Lehman, O. B. West and M. W. Thomson.

CEDAR, IOWA—Union Telephone Company. $10,000. Incorporators: C. A. Moore, Moses Picken, J. L. Moore and others.

TOLUCA, ILL.—Toluca Electric Light and Gas Company. $15,000. Incorporators: C. H. Devlin, H. Duggan and D. M. Wood.

FRANKFORT, KY.—Hancock County Telephone Company. $3,000. Incorporators: I. C. and L. Adair and W. E. Ford.

JERSEY CITY, N. J.—National Electric Improvement Company. $2,000. Incorporators: S. C. Smith and Le Grand Bouker.

CAPE MAY, N. J.—Ocean Street Passenger Railway Company. $4,000. Incorporators: R. M. Oberteuffer and Charles Heebner.

LAKE PLACID, N. Y.—Lake Placid Electric Light Company. $10,000. Directors: Melville and Anna Dewey and A. O. Gallup.

CLINTON, MO.—Clinton Light and Water Company. $180,000. Incorporators: J. M. Avery, Paul Tyler, J. T. Marsh and others.

KANSAS CITY, MO.—B.-R. Electric Company. $40,000. Incorporators: T. M. Bernardin, E. R. Rorer, J. E. Taylor and others.

MOHAWK, HANCOCK COUNTY, IND.—Mohawk Telephone Company. $1,995. Directors: G. W. Allen, S. J. Scott and others.

NEW YORK, N. Y.—General Tunnel Engineering Company. $100,000. Directors: D. J. Newlands, W. H. Knight and F. M. Laude.

BOSTON, MASS.—Electric Manufacturing Company. $650,000. Promoters: J. A. Haskell, G. H. Butters, James Dean and others.

CHARLES CITY, IOWA—Charles City Electric Railway Company. $100,000. Directors: E. Waller, J. E. May, S. L. Korn and others.

MARION, ILL.—Coal City Electric Railway Company. $100,000. Incorporators: P. M. Johnston, F. P. Read and C. M. Atterbury.

ROME, N. Y.—Rome Gas, Electric Light and Power Company. $400,000. Directors: J. T. Lynn, M. B. Daly, F. Shelley and others.

BOSTON, MASS.—New England Electric Manufacturing Company. $30,000. Promoters: G. O. and G. H. Proctor and C. H. Pease.

PARIS, TEX.—Paris Transit, Light and Power Company. $250,000. Incorporators: R. H. Cornell, S. B. Long, W. F. Little and others.

RICHARDSON, DALLAS COUNTY, TEX.—Richardson Telephone Company. $750. Incorporators: W. N. Stults, C. H. Blewett and others.

INDIANAPOLIS, IND.—Central Traction Company. $200,000. Directors: F. M. Fauvre, J. W. Chipman, Ansel Fautout and others.

SPRINGPORT, MICH.—Springport Mutual Telephone Company. $5,000. Directors: S. E. Whitman, G. M. Tabor, C. G. Wilkes and others.

PRINCETON, MINN.—Minnesota Rural Telegraph Company. $50,000. Incorporators: L. Rust, C. T. Johnson, E. L. Saxon and others.

HAVERSTRAW, N. Y.—Haverstraw Auto-Service Company to operate a stage route for Rockland County. $10,000. Director: G. P. Hilton.

LITTLE ROCK, ARK.—Walnut Hill Telephone Company. $2,500. J. F. McKnight, president; D. D. Hamiter, secretary and treasurer.

BINGHAMTON, N. Y.—G. & E. Electrical and Construction Company. $12,000. Directors: N. H. Gaylor, E. Isherman and F. Eitapenc.

TOLEDO, OHIO—Toledo-Bryan Air Line Railway Company. $1,250,000. Incorporators: J. L. Yost, L. V. H. Collins, J. Bonner and others.

ASTORIA, WASH.—Astoria Electric Company. $300,000. Paid-up capital $160,000. President, C. A. Coolidge; secretary, H. M. Bransford.

NAPOLEON, OHIO—Henry County Home Telephone Company. $50,000. Incorporators: E. L. Barber, S. M. Heller, F. D. Prentiss and others.

CARTHAGE, N. Y.—Carthage Electric Light and Power Company. $75,000. Directors: J. E. Strickland, P. J. Corcoran and T. B. Basselin.

LACKAWANNA, PA.—The Lackawanna & Wyoming Valley Rapid Transit Company has increased its capital stock from $2,850,000 to $5,000,000.

ALBANY, N. Y.—Albany Home Telephone Company. $750,000. Directors: S. P. Rawson, I. H. Griswold, F. H. Sudro, A. E. Lord, T. M. Brush and others.

TRENTON, N. J.—Pan-American Motor Company. $100,000. Incorporators: A. T. Thompson, H. W. Whipple, W. M. Power, J. F. Fox and H. G. Derby.

HAWEY'S LAKE, N. J.—Hawey's Lake Miniature Electrical Railway and Light Company. $100,000. Incorporators: H. Flanders and E. Schwabenland.

PORTLAND, ME.—National Automobile and Motor Company. $350,000. Incorporators: H. B. Clark, S. C. Allen, L. H. Howell and L. H. Abrams.

MIDDLEPORT, NIAGARA COUNTY, N. Y.—Middleport Gas and Electric Light Company. $50,000. Directors: W. C. Johnson, F. A. Dudley and L. E. Sterritt.

CANTON, OHIO—Canton, Massillon & Akron Railway Company. $1,000,000. Incorporators: The officers and stockholders of the Northern Ohio Traction Company.

SARATOGA SPRINGS, N. Y.—Saratoga Telephone and Telegraph Company. $125,000. Directors: F. K. H. Beach, C. W. Coal, S. C. Medbery, W. P. Burtley and others.

WATERFORD, N. Y.—The Warren County Railway Company has increased its capital stock from $200,000 to $500,000, and will issue a first mortgage of $600,000.

TROY, N. Y.—Troy, Rensselaer & Pittsfield Railway Company. $350,000. Directors: E. F. Murray, R. C. Bull, Frank S. Black, W. D. Barnes, J. S. Coutie and others.

WADENA, MINN.—Iron Range & Electric Telephone Company. $50,000. A. B. Kerlin, president; C. W. Baumbach, secretary; W. R. Baumbach, vice-president and treasurer.

TIFFIN, OHIO—Tiffin & Southwestern Electric Railway Company. $50,000; with privilege of increase to $2,000,000. Directors: Henry Price, W. J. Ochs, W. S. Rogers, L. Selle and others.

PITTSBURGH, PA.—Webster, Monessen, Bellevernon & Fayette City Street Railway Company. $60,000. Incorporators: S. M. Graham, Colonel James M. Schoonmaker, F. M. Fuller and others.

OSAGE, O. T.—Osage & Eastern Oklahoma Telephone Company. $10,000. President, J. H. Clapp; D. L. Huller, vice-president; O. A. Elliott, secretary.

CINCINNATI, OHIO—The Cincinnati Gas, Light and Coke Company has increased its capital stock from $9,500,000 to $28,000,000, and changed its name to the Cincinnati Gas and Electric Company. Andrew Hickenlooper, president; Henry M. Sage, secretary.

Electrical Securities

The course of the market during the past week would indicate that there is a disposition towards restraining the "boom." There is much confidence in evidence, however. The market values on the New York Stock Exchange have shown considerable firmness and the situation is generally satisfactory. Speculation is now within much safer limits and the lesser number of transactions was chiefly due to the elimination of a reckless speculative element which had become a more or less dangerous feature in the market. Money is easy and promises to remain so. Railroad earnings, and particularly industrial earnings, are large. General business is fairly active in the whole country which is in the enjoyment of prosperity.

ELECTRICAL SECURITIES FOR WEEK ENDING MAY 25.

New York:	Highest.	Lowest.	Closing.
B'klyn R. T.	77	74⅞	75⅝
Con. Gas	223⅞	217	219¾
Gen. Elec	224	220¼	223
Man El.	115¼	112	114¼
Met. St. Ry.	34	32	32
Third Ave. R. R.	120	120	120
Kings County Electric	...	...	195
N. Y. and N. J. Tel. Co.	...	...	170
Telep., Tel & Cable Co.	...	...	7

The chief feature of interest in electrical circles was the new storage battery invented by Edison. Its practical use is waited with much interest. Other storage battery interests are somewhat skeptical as they have all passed through series of experiments, the result of which has caused them to be very conservative. Still the admission is general that Edison has brought into the field several new factors and ideas. A director of the Electric Storage Company is quoted as saying: "While Mr. Edison is a great inventor, he is inclined, as men of genius oftentimes are, to be quite enthusiastic, and it remains to be seen wnether his storage battery will in actual operation do all that he claims for it. The trouble with all storage batteries is that they can be changed by adding a little thing here or a litcle there, so that it is almost impossible to control them by patents. We have experts constantly at work improving our own batteries, and we have lately produced one which is a great improvement over those previously in use, having a decreased weight and increased efficiency."

The recent decline in shares of the New York Electric Vehicle Transportation Company is largely due to the assessment of $10 per share. This assessment is to be used in the purchase of improved vehicles whereby it is expected the cost of operation will be greatly reduced. A new battery is being installed and a pronounced reduction in operating expenses is to be expected.

Boston, May 25:	Closing.
Am. Tel. and Tel.	179½
Erie Tel.	58
New Eng. Tel.	142
Mass Elec. c.	35¼
Westing. Mfg.	63
Edison Elec.	260

The new issue of stock of the American Telephone and Telegraph Company will make a very substantial "plum" for present stockholders. It is understood that they will be permitted to take one share of new stock at par for three now held. This will give the rights a value of $20 for each share. Twenty-one million dollars of new stock it is understood will be the amount issued.

The *Boston News Bureau* reports that the entire lot of $7,500,000 of Erie Telephone Company's notes, representing the loan due January 10, 1902, has been disposed of. The regular meeting of the directors of the Erie Telephone Company will be held in Boston, on Tuesday, June 25. The Stone & Webster favorable report of the physical condition of the plant will then be officially presented to the board.

There was a 3-point advance in Massachusetts Electric companies common stock. Through the recent favorable legislation, whereby all the companies are consolidated into two operating companies, the common stock is said to be within sight of dividends, for through known economies by reason of this consolidation there is a saving of at least $250,000 per year, equal to 1½ per cent for the common stock.

Chicago, May 25:	Closing.
Chicago Edison Light	177
Central Union Telephone	48
Chicago Telephone	260
Un. Trac.	16
Un. Trac. pf.	60
Metropolitan El.	169¾

It is again reported that the Chicago Edison Company is to be absorbed by the People's Gas, although President Samuel Insull, of the former concern, does not think that a merger is probable. Strong interests in the Gas company state that the consolidation planned was nearly completed a fortnight ago, but was delayed through a disagreement on some minor detail.

Union Traction has been very active during the past week.

Philadelphia, May 25:	Closing.
Elec. Co. of A.	9¼
Philadelphia Elec	5⅞
Union Traction	31¼
United G. I. Co.	117½
Elec. Sto. Bat. c.	56
Elec. Sto. Bat. pf.	56

There was a slight falling off in the price of Storage Battery on account of the reports of the new Edison storage battery. The stock remained firm, however, around 56.

It is expected that the 5 per cent bonds to be issued by the merger of the United Electric Railways and the Electric Company of America, will command a good price. The Philadelphia *Inquirer*, of Wednesday of last week, reports as follows: "Everywhere one went yesterday brokers and customers were found busily engaged figuring upon the value of the rights afforded stockholders of American Railways, Electric Company of America and Consolidated Lake Superior. There were so many hypothetical propositions that every group had a different result after making a calculation. But while the mathematicians were at work the tape settled the difficulty for the Consolidated shareholders by announcing sales at $2, then at $3, and later at $4, and $5 was said to be bid on the curb."

Educational News

THE UNIVERSITY OF PENNSYLVANIA is in receipt of a gift of $200,000 donated by Mr. Randall Morgan, of Philadelphia, one of the trustees of the University. The money will be devoted to erecting a new physical laboratory which will be known as the "Morgan Laboratory of Physics."

WAYLAND ACADEMY, of Beaver Dam, Wis., has received $7,000 from Mr. John D. Rockefeller, the gift being conditional upon the raising of an additional $20,000 by July 1. The secretary of the academy, the Rev. Mr. Catchpole, states that $17,500 has already been secured and the remainder will be raised easily. A new hall is to be built with the money.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS, Scranton, Pa., have recently received from the Franklin Institute, on behalf of the National Export Exposition, the highest award of that body for an exhibit; the award consisting of a silver medal and a diploma. The diploma states that the award was made for "a unique, thorough and comprehensive system of instruction by correspondence." The schools value the award most highly, the encomiums bestowed upon them by the wording of the diploma making the award one of unusual character and importance.

Telephone and Telegraph

A franchise has been granted to the United Telephone Company by the town of Andrews, Ind., and construction work has already been begun.

A 30-year franchise has been granted by the city council of Hillsboro, Tex., to a local independent telephone exchange. Mr. A. L. Lowrey is interested.

Two telephone companies have secured franchises in Arcadia, Ohio, the first being the Findlay Home Telephone Company, and the latter the Central Union, which will build a plant in conjunction with the one in Fostoria.

The Waterbury, Ct., Automatic Telephone Company, which recently voted to go out of existence because of the new law which makes it necessary for independent companies to apply to the Superior Court for a charter, decided at a more recent meeting to continue the organization.

A franchise has been granted to the People's Telephone Line by Victor, N. Y., for a local exchange. A branch line will also be built from Victor to East Bloomfield. The service which the company is maintaining is said to prove a great accommodation to residents of the rural districts.

At the recent annual meeting of the stockholders of the Eastern Telephone and Telegraph Company, it was decided to extend the company's lines to Atlantic City and Cape May, N. J. Connections will also be made with the Keystone Company, of Philadelphia. During the past year the company spent $150,000 in extending its service.

It has been decided by the Pittsburgh & Allegheny, Pa., Telephone Company, which controls the Allegheny County Telephone Company, of Braddock, to rebuild the entire system of the latter company. The cost of the work is estimated at about $50,000, and the Braddock exchange will not be connected with Pittsburgh for some months.

The Citizens' Telephone Company, of Toronto, Ohio, has recently been organized and the local telephone company's property and franchises taken up by it. Mr. W. F. Crossley is the president and general manager, and W. L. Carey, of Cleveland, is secretary. The system in Toronto itself will be rebuilt and renewed and a line constructed from Atlanta to Wellsville.

The United States Navy, through Admiral Bradford, chief of the Naval Bureau of Equipment, has officially adopted, so far as possible, the use of wireless telegraphy and recommended, in the report of the Bureau which investigated the question, that the use of homing pigeons be discontinued as soon as wireless telegraphy can be introduced successfully into the navy. No new pigeon cotes will be established

A large number of long-distance circuits extending in all directions from Atlanta, Ga., are being strung by the Southern Bell Telephone Company. General Manager W. T. Gentry recently stated that within a few days the company would have a dozen or more new circuits leading out of the city completed and ready for business. A new line is going up between Atlanta and Charlotte, N. C., another to Chattanooga, Tenn., two to Macon, Ga., and another to Griffin. An additional copper circuit is also being run between Macon and Thomasville so as to give two circuits to that city. Two others are being run from Montgomery, Ala., to Atlanta, which will make four in all when complete.

Industrial Items

THE CLIFTON MANUFACTURING COMPANY, of Boston, has removed to 220 Devonshire street.

THE FRANK S. DE RONDE COMPANY recently moved to 46 Cliff street, New York; the reason for the move being that the company is "hunting for more room."

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, is sending out a neat little catalogue describing the Whitney instruments of precision, 1901 edition.

THE LINCOLN ELECTRIC COMPANY, Cleveland, Ohio, manufacturer of dynamos and motors, has recently installed some of its equipment for the United States Government on vessels of the navy.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has just published a book cataloging in a most complete manner, its new hotel telephone, intercommunicating telephone and annunciator systems.

THE PERU ELECTRIC MANUFACTURING COMPANY, of Peru, Ind., has just published a booklet entitled "Peru Mains and Branches," and "Reasons for Their Existence." This booklet is something new and novel. It is sent free.

THE SAWYER-MAN ELECTRIC COMPANY announces that it has recently opened new works in New York city at 510 to 530 West Twenty-third street. The general office and principal works of the company hereafter will be at this place.

THE PEERLESS ELECTRIC TELEPHONE COMPANY, Rio, Wis., is mailing its catalogue of telephone apparatus, including everything from magneto bells and appliances to fully equipped switchboards. Full particulars and information regarding the apparatus will be sent on application to any one interested.

ON MAY 22 the General Incandescent Arc Light Company, of 572 First avenue, New York, manufacturers of arc lamps, switches, switchboards' power motors, flush switches, etc., arranged with its employés to run the factory 54 hours per week and pay the same wages as were paid when the factory was running on a 60-hour basis.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY, of Chicago, Ill., recently removed its offices from Jefferson street to the Fisher Building. This company's factory is located at Winthrop Harbor, Ill., where all materials should be shipped. All correspondence, however, should be addressed to the company at Fisher Building, Chicago.

MR. W. F. WARNER, of Muncie, Ind., the inventor and patentee of the Warner pole-changer for ringing telephones, has perfected an electrical piano-playing attachment, which is constructed on new lines. Mr. Warner has organized a company for its manufacture. The factory will be located in Muncie, Ind., and operations are expected to commence about the first of July.

THE KUHLMAN CAR COMPANY, of Cleveland, Ohio, which is a reorganization of the old G. E. Kuhlman company, has just been incorporated with a capital stock of $300,000. It is said that the growing demand for Kuhlman cars has warranted the company in extending its operations and in erecting a large plant in which steam as well as street and interurban electric cars will be built. The new factory will have a capacity of 500 cars per year, and will be erected within a few miles of Cleveland.

THE H. W. JOHNS MANUFACTURING COMPANY, 100 William street, New York, is mailing a folder with pasters illustrating in colors its floor paints. The product of the Johns company is well known throughout the country and the careful manufacturing methods of this organization have made an enviable reputation for it. Full particulars and information with prices of paints and other materials made by this company will be forwarded post free upon application.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is receiving good orders for electric fixtures (chandeliers, brackets and portables). This company can furnish anything desired in this line of material at attractive prices and is in a position to make prompt shipments. Before making shipments the Central company is very careful to see that the goods are exactly as the customer ordered—a precaution which will be readily appreciated by purchasers of electric fixtures.

THE STERLING-MEAKER COMPANY, 141 to 155 East Twenty-fifth street, New York city, manufacturer of street car registers, brakes, etc., is particularly busy at the present time. Last month was the biggest month in the history of the company and the outlook for a particularly busy summer season was never so encouraging. The company has orders ahead for over 1,000 registers and for nearly the same number of brakes. Its foreign business has been constantly growing during the past 12 months and has become a very important part of the company's business.

THE STAR DYNAMO WORKS, Jefferson City, Mo., makers of direct-current bipolar and multipolar dynamos and motors, are mailing circular matter describing their small and medium sizes of electric motors and incandescent electric lighting machines. In addition to such apparatus the company make a specialty of furnishing complete incandescent electric lighting plants with directions for erecting. Complete lists covering the different standard outfits will be mailed by the company on application, with full particulars and prices, with specifications ranging from 15 to 100-light plants.

THE AMERICAN BRIDGE COMPANY, New York city, is building at its Minneapolis branch the structural steel which will be used in the construction of the Webster County court-house, at Fort Dodge, Iowa, and will also turn out the buildings for the Allegheny Steel and Iron Company, for a steel plant at Brackenridge, Pa. This last order will necessitate six complete buildings and three lean-tos, making about 500 tons of steel in all. Besides this, the company has obtained the contracts from the Berlin Iron Bridge Company for four bridges for the province of New Brunswick, Canada.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, manufacturer of the chloride accumulator, has recently closed a contract with the Minneapolis General Electric Company for the enlargement of that corporation's present storage battery, which was installed in October, 1899, and its removal to a new location. The original installation consisted of 140 elements of type H-31 in H-39 lead-lined tanks, and had a capacity at the normal rate of discharge of 4,000 ampere-hours. By burning eight additional plates to the bus-bars of each element this capacity is now brought to a normal discharge rate of 5,000 ampere-hours.

FRED M. LOCKE, Victor, N. Y., is mailing his test circular No. 8. The circular is a neat folder which embodies the results of tests made by Professor Harold B. Smith, professor of electrical engineering in the Worcester Polytechnic Institute, Worcester, Mass., upon Locke insulators. The figures given are very complete and are of interest to any electrical man who has occasion to use insulators for any sort of work. The No. 6 telephone porcelain insulator and the No. 3 triple-petticoat porcelain insulator are claimed by manufacturers to be meeting with decided success, inasmuch as they are both cheaper and stronger than glass. Prices are quoted on the insulators, finished either in brown or white, for street railway work. All requests for catalogues, price lists or other information will be cheerfully attended to and replies promptly made.

THE WESTERN ELECTRICAL SUPPLY COMPANY'S (St. Louis) telephone department has just issued a number of bulletins covering its new telephones, switchboards, etc. These are bound up in catalogue form, and embrace everything pertaining to the complete equipment, construction or maintenance of a telephone line or exchange. They illustrate a large number of new devices for the economical operation of lines and exchanges. Improvements in the telephone and switchboard devices in the last year have been notable. Among the new things shown are loud-ringing extension gongs, developed in response to a demand for an extension bell to be used on telephone lines in noisy places, adjustable arms, and long-distance transmitters, with solid backs. The new ideal bridging telephone embodies a number of novel features, making it, the maker claims, the highest grade long-distance telephone produced. The bulletins also show a very attractive looking receiver with a covered diaphragm, which appears to be a considerable improvement over the old style. Any one contemplating installing a new exchange, or making additions and improvements of any kind, would do well to obtain a copy of these bulletins. They are mailed on application.

THE AMERICAN DISTRICT STEAM COMPANY, Lockport, N. Y., is mailing its catalogue for 1901. The book at hand is a very handsomely gotten up 36-page catalogue, dealing at length with the Holly system of direct and exhaust steam heating through underground mains. Many illustrations of the component parts of the apparatus make the book notable, while in the back part are given maps of streets where the company's system is installed, the longest being one of 20,848 feet of street mains and 5,350 feet of service mains. This particular installation furnishes heat to 206 houses containing 7,000,000 cubic feet of space. The elevation of the highest building above the boiler plant is 297 feet and the initial pressure carried at the station is four and one-half pounds. Points of interest in the book are the matters of cost of maintenance, economy of operation, durability of plant, the abandonment of old methods, profits, saving in cost of labor, kind and amount of fuel used, and saving in aggregate cost of boiler insurance. The subject of exhaust steam heating appeals especially to power companies, which either regard their exhaust steam as a waste by product or one for which they get but small return by means of condensers. The company now has 176 plants in operation using this system.

THE GOULD STORAGE BATTERY COMPANY made an interesting exhibition at the recent electric light convention, insomuch as it showed battery plates formed and unformed, both positive and negative, from the smallest to the largest size. Among them were plates which had gone through a series of discharges representing over a year's work in ordinary use and showing no apparent depreciation. These plates, it is said, had been subjected to 317 discharges. Over 100 of them at a 20-minute rate and the same number at a half-hour rate and also one three-and-one-eighth-hour rate. "Spinning," the method employed in the construction of the Gould battery for subdividing the lead and obtaining a large contact surface for the active material, was exemplified by numerous specimens showing the ratio of 20 to 1 and as high as 450 square inches per pound of lead; the automobile type was shown which, with 13 pounds of element, is announced to give 100 ampere-hours on a four-hour rate; also different types of plates which have been recently installed were shown. Among the recent installations the following equipments of the Gould batteries may be noted: The Oakdale, L. I., residence of W. K. Vanderbilt; the Commercial Office Building, New York city; the Edison Station, Canton, Pa.; the Lansing Street Railway, Lansing, Mich.